Cornell University
Announcements

New York State College of Agriculture and Life Sciences: Courses

A Statutory College of the State University
At Cornell University, Ithaca, New York

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1974–75

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Cornell University Announcements

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1974–75

Cornell Academic Calendar

Registration, new students	Thursday, August 29
Registration, continuing and rejoining students	Friday, August 30
Fall term instruction begins	Monday, September 2
Thanksgiving recess:	
Instruction suspended, 1:10 p.m.	Wednesday, November 27
Instruction resumed, 7:30 a.m.	Monday, December 2
Fall term instruction ends, 1:10 p.m.	Saturday, December 7
Final examinations begin	Friday, December 13
Final examinations end	Saturday, December 21
Registration, new and rejoining students	Thursday, January 23
Registration, continuing students	Friday, January 24
Spring term instruction begins, 7:30 a.m.	Monday, January 27
Spring recess:	
Instruction suspended, 1:10 p.m.	Saturday, March 22
Instruction resumed, 7:30 a.m.	Monday, March 31
Spring term instruction ends, 1:10 p.m.	Saturday, May 10
Final examinations begin	Monday, May 19
Final examinations end	Wednesday, May 28
Commencement Day	Monday, June 2

The dates shown in the Academic Calendar are subject to change at any time by official action of Cornell University.

In enacting this calendar, the University Senate has scheduled classes on religious holidays. It is the intent of Senate legislation that students missing classes due to the observance of religious holidays be given ample opportunity to make up work.

Summer Sessions Calendar, 1974

Registration, three week summer session,* three-week summer session instruction begins	Wednesday, June 5
Registration, eight-week summer session, eight-week summer session instruction begins	Monday, June 17
Three-week summer session instruction suspended	Monday, June 24
Three-week summer session final examinations, three-week summer session ends	Tuesday, June 25
Registration, six-week summer session	Wednesday, June 26
Six-week summer session instruction begins	Thursday, June 27
Six- and eight-week summer sessions instruction suspended	Wednesday, August 7
Six- and eight-week summer sessions final examinations begin	Thursday, August 8
Six- and eight-week summer sessions end	Friday, August 9

* All dates for the three-week session are tentative.

Announcement

Contents

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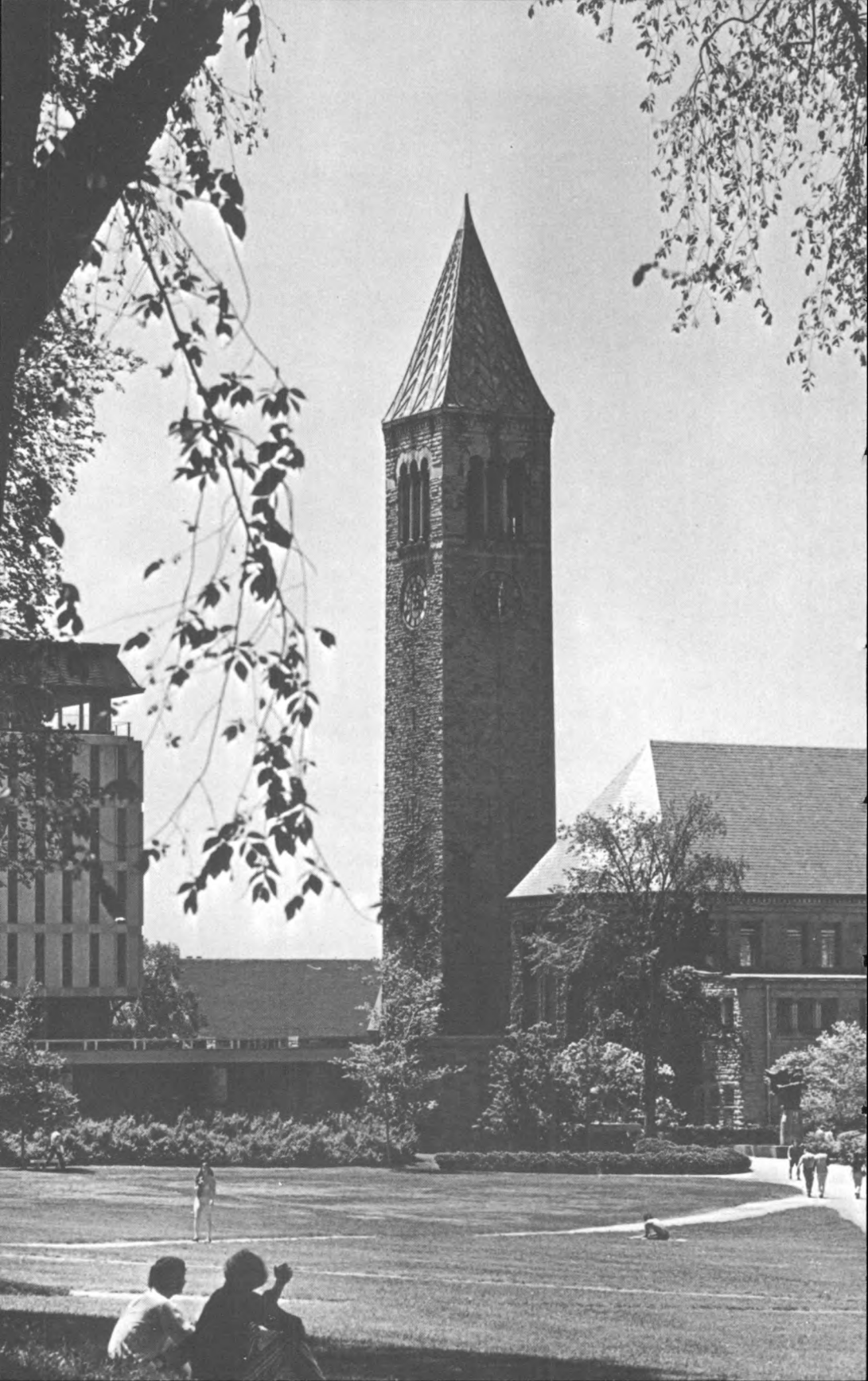

Cornell University

Courses of Instruction

The courses and curricula described in this *Announcement,* and the teaching personnel listed herein, are subject to change at any time by official action of Cornell University.

The courses offered in the New York State College of Agriculture and Life Sciences are listed by departments. They are numbered according to the following system:

100–299: Courses primarily for underclassmen (freshmen and sophomores). They include introductory courses; 200 courses may carry prerequisites, or courses or class stipulations.

300–499: Courses primarily for upperclassmen (juniors and seniors) and graduate students.

600–699: Courses primarily for graduate students.

700–799: Courses restricted to graduate students except with permission of the instructor.

899: Master's thesis and research

999: Doctoral thesis and research

A new course numbering system is being introduced. In instances where a course number has been changed, the old course number will follow in parentheses.

Grades A–F are used in the College. Also, S (Satisfactory) and U (Unsatisfactory) grades are given in courses where specified. Students above the freshman level may take as many courses for S-U grades as they wish each term, but to be eligible for graduation, at least 100 hours of course work must be completed with regular letter grades. Courses designated for S-U grade may not be in the student's specialization, nor may they be used to satisfy specific course and distribution requirements.

Orientation

5 Orientation. Fall or spring term. Credit three hours. The credit is not counted toward the 120 hours required for the degree. Fall term: for entering students only. M W F 8 (two sections) or 12:20 (two sections). Spring term: may be elected by first-year students only. M W F 12:20. Instructor to be appointed. Emphasis on the analysis and reasoning involved in the solution of verbal problems which have been drawn mainly from College of Agriculture and Life Sciences courses requiring the use of mathematics.

7 College Reading and Study Skills Program. Twice each term. Noncredit. S-U grades only. Program 1 starts one week after the beginning of fall term; Program 2, directly after Thanksgiving recess; Program 3, at beginning of spring term; and Program 4, directly after spring recess. Programs are open to all registered students. Students may register by telephoning 256-3413, or by coming to Olin 375 during the insession week preceding the beginning of each program. W. Pauk. Principles and techniques for more effective reading and studying are explained, demonstrated, and practiced in class. The reading laboratory provides an opportunity for increasing one's rate of reading.

27 Introduction to Farm Techniques. Spring Term. Noncredit. S-U grades only. One Laboratory period a week. Time to be arranged. Instructor to be appointed.
Provides supervised instruction in the basic manual skills of farming. Skills covered include hand and machine milking, livestock handling, operation of tractors and field equipment, and general orientation to the practices and procedures of day-to-day farm operation. Registration for the course and information regarding time and location are handled by the Office of Student Services, 16 Roberts Hall.

115 (110) Introductory College Mathematics. Fall or spring term. Credit four hours. M W F 8, 12:20. Laboratory, T or Th 12:20. H. A. Geiselmann.
Designed to give students with sound high school mathematics backgrounds a unified treat-

ment of the basic concepts of college algebra, analytic geometry, and the elements of calculus. Considerable emphasis will be placed upon the concept of function, graphing, problem solving, and methods of proof. The Cornell University Computing Language (PL-C) will be taught and used to strengthen and integrate the mathematical topics covered in the course.

Agricultural Economics

Farm Business Management and Finance

302 Farm Business Management. Spring term. Credit four hours. Not open to freshmen. Agricultural Economics 302 is a prerequisite for 402. Lectures, M W 10:10. One discussion period, F 9:05, 10:10, 11:15, or 12:20. Laboratory, T W or Th 1:25–4:25. On days farms are visited, the laboratory period is 1:25–5:30. One all-day trip and four half-day trips are taken to visit farm businesses. G. J. Conneman.
Focus is on the intensive study of problems associated with planning, organizing, operating, and managing a farm business. Emphasis is placed on the tools of managerial analysis and decision making. Principal topics considered include factors affecting profits, management information systems, business analysis, economic principles, complete and partial budgeting; acquisition, organization and, management of capital, labor, land, and machinery. The influence of technology and the contribution of related sciences and their importance to managers are covered.

402 Advanced Farm Business Management. Spring term. Credit three hours. Prerequisite: 302. Lecture, M W 10:10. Laboratory, W 1:25–4:25. On days farms are visited, the laboratory period is 1:25–5:30. G. L. Casler.
Emphasis is placed on evaluating the profitability of alternative investments and enterprises. Principal topics include linear programming, capital budgeting, influence of change on farm organization, financial risk and uncertainty. Experience in computer applications to farm business management is provided.

405 Farm Finance. Spring term. Credit three hours. Prerequisite: 302. Lectures, T Th 10:10. Discussion, T 1:25–3:20. R. S. Smith.
A study of sound financial arrangements for farmers and the credit institutions which serve them. Emphasis is placed on problems of capital management associated with organizing and operating a commercial farm. Alternative sources of capital are analyzed and consideration given to safe and profitable debt levels and selection of alternative investment opportunities. Tax management, insurance programs, and retirement and estate planning for farmers are also studied.

406 Farm Appraisal. Fall term. Credit three hours. Prerequisite: 302. Lecture, T 10:10. Laboratory, T 1:25–4:25 or Lecture, Th 10:10. Laboratory, Th 1:25–4:25. On days when farms are visited, laboratory period is 1:25–5:30. C. W. Loomis.
A study of factors governing the price of farms, methods of farm valuation, and practice in the appraisal of farms and other rural properties.

608 (508) Production Economics. Spring term. Credit three hours. Limited to seniors and graduate students. Prerequisite: Economics 102 or equivalent; Math 108 or Math 111 or equivalent suggested although not required. Lectures, T Th 11:15. Discussion, M 1:25–3:20. E. L. LaDue.
A comprehensive survey of production economic theory with emphasis on applications to agriculture and agribusiness. Topics covered include the derivation and use of production, cost, and supply functions. Some time is spent on the application of production theory to special problem areas such as education and environmental quality.

Business Management

Attention is directed to courses in economics and mathematics in the College of Arts and Sciences and in administration in the Schools of Hotel Administration, Business and Public Administration and Industrial and Labor Relations.

220 Introduction to Business Management. Fall term. Credit three hours. Lectures, M W F 10:10. Discussions, W 1:25–3:20, Th 8–9:55, 11:15–1:10, 1:25–3:20, 7:30–9:25 p.m., F 9:05–11, 10:10–12:05. In weeks discussions are held, there will be no Friday lecture. D. R. Lifferth.
Emphasis will be placed on principles of business management, taking into account the social, legal, and economic environment in which business decisions are made. Topics include: the historical development, structure, and regulation of American business; principles of management relating to decision making, planning, directing, organizing, and controlling; and contemporary issues of business and society.

221 Accounting. Spring term. Credit three hours. Lectures, M F 10:10. Laboratory, T W or Th 9:05–11, 12:20–2:15 or 2:30–4:25. D. A. Eiler.
A comprehensive study of basic financial accounting principles. An introduction to cost accounting and the analysis and interpretation of financial statements. Emphasis on accounting concepts rather than procedures.

320 Business Law. Fall term. Credit three hours. Limited to upperclassmen. M W F 9:05. One preliminary examination will be given at 7:30 in the evening. J. B. Bugliari.
Consideration is given chiefly to legal problems of particular interest to persons who expect to engage in business, with emphasis on the fields of personal property, contracts, agency real property, partnerships and corporations.

321 (320H) Business Law. Fall term. Credit four hours. Limited to upperclassmen with permission of the instructor. Lectures M W F 9:05. Discussion M 3:35. One preliminary examination will be given at 7:30 in the evening. J. B. Bugliari.
The lecture portion of this course will cover the same material as 320. The discussion portion will deal with practical applications of certain of the legal principles covered in the course such as contract formation, real property transactions, incorporation and management of business enterprises, and attempt also to give some deeper insight into the role and function of the lawyer and the judiciary in our society.

322 Taxation in Business and Personal Decision Making. Spring term. Credit three hours. Recommended prerequisites: at least one course in accounting (e.g. Ag. Econ. 221) and a course in business law (Ag. Econ. 320). M W 2:30–4. J. B. Bugliari and R. S. Smith.
Deals with taxation both state and federal and its impact on business and personal decision making. State and local real property, income and sales taxes, and federal income and estate and gift taxes will be explored both as they affect individuals and corporations. Particular attention will be given to income tax management for operators of unincorporated businesses and smaller corporate firms. Both tax policy and the mechanics of taxation will be covered.

323 Managerial Accounting and Economics. Fall term. Credit three hours. Prerequisites: 221 and Economics 102 or their equivalents. Lectures, T Th 10:10. Discussions, Th 12:20–2:15, 2:30–4:25; F 9:05–11, 1:25–3:20. R. D. Aplin.
Designed to relate accounting and economic principles to management decision making and control. Major topics covered include cost behavior; volume-profit relationships; standards and flexible budgets for planning and control; responsibility accounting and the contribution approach to cost allocation; measuring divisional performance; relevant cost analysis for decision making; linear programming; and inventory planning and control systems.

324 Managerial Economics and Financial Management. Spring term. Credit three hours. Prerequisites: 221 and Economics 102 or their equivalents. Students who have not taken 323 will be expected to attend a special section each of the first two weeks of the term. Lectures, M W F 9:05. Discussions, W 2:30–4:25, Th 8–9:55, or 12:20–2:15, F 9:05–11:00 or 12:20–2:15. In weeks when discussions are held, there will be no Friday lecture. R. D. Aplin.
Emphasis is placed on identifying problems in a business, recognizing alternatives, and using economic data as guides to making decisions. A major portion of the course deals with the economic evaluation of capital investment projects. The other major portion deals with financing and dividend policies. Class discussion is supplemented by case studies to illustrate concepts and techniques available to management to assist in making sound decisions.

326 Farmers' Cooperatives. Spring term. Credit three hours. Not open to freshmen. M W F 9:05. Professor to be appointed.
What cooperatives are, what they have tried to do, and what they have done; their legal status and special problems of organization, finance, and control.

420 (321) Advanced Business Law. Spring term. Credit three hours. Prerequisite: 320 or its equivalent. T Th 8–9:55. One preliminary examination will be given at 7:30 in the evening. J. B. Bugliari.
Designed for those students who plan business careers in which a more detailed and comprehensive legal background could be utilized. Selected areas covered in 320 will be further developed, and particular consideration will be

given to the law pertaining to bailments, sales, secured transactions, bankruptcy, negotiable instruments, insurance, and trusts and estates.

421 (321H) Advanced Business Law. Spring term. Credit four hours. Limited to upperclassmen with permission of the instructor. Lectures, T Th 8–9:55. One preliminary examination will be given at 7:30 in the evening. Discussion T 3:35. J. B. Bugliari.
The lecture portion of this course will cover the same material as 420. The discussion portion will deal with practical application of certain of the legal principles covered in the course, such as sales contracts, consumer protection, mortgage transactions, bankruptcy proceedings, negotiable paper, insurance, and drawing a will.

424 Managerial Decision Making. Spring term. Credit three hours. Limited to seniors with advisers in Agricultural Economics. T Th 10:10–11:40. W. G. Earle.
An integrating course which examines business policy formulation and execution from the standpoint of the corporate manager. Designed as an advanced course for potential business managers and/or owners which will encompass the concepts and function of strategy, the nature of a company's environment, the interdependence of formulation and implementation of strategy, and the role of leadership in achieving business goals.

425 Personal Financial Management. Spring term. Credit two hours. Lecture F 12:20. One hour discussion each week, time to be arranged. Primarily for seniors. R. S. Smith.
Discussion sessions will be devoted to problems and case studies in financial planning for students and young families. Discussion leaders will include representatives of financial institutions including banks and insurance companies.

[726 (626) Seminar in Agricultural Cooperation. Spring term. Credit two hours. S-U grades optional. Open only to graduate students. Time to be arranged. Not offered in 1974–75.
A discussion of the economic theory and function of farmer cooperatives. The place and contribution of cooperatives in developing and developed economies will be considered along with problems of structure, finance, management, and control.]

Marketing and Food Industry Management

240 Marketing. Spring term. Credit three hours. Lecture, M W F 11:15. Discussions: M 2:30–4:25, T 12:20–2:15, 2:30–4:25, W 2:30–4:25, Th 12:20–2:15, 2:30–4:25, F 10:10–12:05. In weeks discussions are held, there will be no Friday lecture. D. C. Goodrich.
A study of how products are marketed. Special attention is given to factors affecting consumption of food products; market channels; operation of marketing agencies; storage; transportation; packaging; product identification; advertising and promotion; buying, selling, and marketing costs; as well as the social issues which many of these create.

346 Marketing Milk and Dairy Products. Fall term. Credit three hours. Lectures, M W F 11:15. Discussion, F 12:20. R. P. Story.
A review of the economic characteristics of the dairy industry, and an analysis of the marketing and pricing systems for market milk. Particular attention will be given to problems and resulting government programs, including marketing orders, price support operations, and public regulation of competition.

441 Food Distribution. Fall term. Credit four hours. Open to juniors, seniors, and graduate students. M W F 10:10 and W 2–4:25. W. G. Earle.
A study of the structure and the competitive nature of the food industry. Particular attention is given to an analysis of the gross margin, expenses, earnings, and performance of food retailers. Government regulations with regard to mergers and buying and selling activities are examined. Leading food industry authorities frequently join the discussion session.

443 Food Industry Management. Spring term. Credit four hours. Open to juniors, seniors, and graduate students. M W F 10:10 and W 2–4:25. W. G. Earle.
A case study approach is used to examine the application of management principles and concepts to operating problems of food retailers. Areas included are site selection, buying, merchandising, personnel administration, private label products, and financing expansion programs. Leading food industry specialists frequently join the discussion session on Wednesday afternoons.

446 Economics of Food Marketing. Spring term. Credit three hours. Open only to seniors. Sections limited to 30 students. Prerequisite: 240 and Economics 311, or permission of instructor. M W F 9:05 or 11:15. D. I. Padberg.
A study of the organization of the agricultural marketing system and the nature of competition developing therein. Food industry structure and performance are appraised in light of current economic theory. Public regulation of competition in food marketing is also covered.

449 Field Study of Marketing Institutions. Spring term. Credit two hours. Registration by permission. M 12:20. G. A. German.
Economic functions performed by various types of specialized marketing agencies, with emphasis on their physical operating patterns. Observations are made of the organization and operation of businesses in the food industry.

Five days of spring vacation are spent in New York City and/or Boston visiting food distribution firms and marketing institutions.

[641 (541) Food Merchandising. Fall term. Credit two hours. Permission of instructor required. Th 2:30–4:25. M. E. Brunk. Not offered in 1974–75.
A seminar exploring alternative merchandising and promotional devices for food industry retailers and manufacturers. Special attention is given to identification and measurement of basic forces having an impact on consumer buying behavior.]

740 (540) Marketing Research. Spring term. Credit two hours. Permission of instructor required. Th 12:20–2:15. M. E. Brunk.
Objectives of marketing research, organization and management of research agencies, problem identification, selecting and planning projects. Special attention is given to the designing and use of research in the management of the marketing function.

741 (641) Marketing Economics. Fall term. Credit three hours. Open only to graduate students. T Th 12:20–2:15. O. D. Forker.
A seminar on marketing economics with special reference to agriculture. Discussions will cover: the strategic role of marketing in the total economic system; the interdependent nature of economic activity in space, time, form dimensions; the measurement and evaluation of the efficiency of pricing and marketing systems; the determination of efficient organizations of assembly, processing, storage, and distribution in a firm and in an industry. The class, as a research team, will study and develop a solution to a marketing problem of an agricultural firm in New York State.

742 (642) Social Responsibility in Marketing. Spring term. Credit three hours. Open only to graduate students. T Th 12:20–2:15. D. I. Padberg.
A seminar course concerned with public policy in marketing. Concepts from industrial organization, consumer economics, and anti-trust are integrated in appraising public decisions in the marketing area. Examples are drawn primarily from analyses of the food marketing system.

Economics of Agricultural Development

464 Economics of Agricultural Development. Spring term. Credit four hours. S-U grades optional. Prerequisite: 150 or Economics 101–102, or consent of the instructor. T Th 9:05 and W 7:30–9:25 p.m. J. W. Mellor.
An examination of the processes of economic development in the developing nations, and their interactions with United States policy. Rural development policy will receive primary attention with emphasis on developing nations with a dominant agriculture sector, on the key role of agriculture in the overall economic transformation of these economies and on interactions of United States agricultural policy as a major component of total United States policy with respect to developing nations.

660 (560) Food, Population, and Employment. Fall term. Credit four hours. M W 2:30–4, plus an individual weekly meeting with the instructor. T. T. Poleman.
Designed to introduce students in the social and biological sciences to the relationships linking employment, food, and population growth in developing countries. Food economics is taken as the cornerstone: examined are human food requirements, the major food groups and their economic characteristics (including historical trends in food consumption), techniques of national food accounting (including data collection and evaluation), the projection of demand, and the disaggregation of data for analysis of particular problem groups and areas (notably the burgeoning number of urban dwellers and peasants bypassed by technological change). In treating the historical relationships between food and population, emphasis is placed on employment, income generation, and effective demand. Students are given ample opportunity to work with SAMI and other vital-rate monitoring devices. A term paper is expected.

665 Seminar on Latin American Agricultural Policy. Fall term. Credit three hours. Prerequisite: basic economics. Knowledge of Spanish or Portuguese is desirable. T 2:30–4:25, plus a weekly meeting with the instructor. D. K. Freebairn.
An examination of policies for the development of the agricultural sector in Latin America, including an identification of policy objectives and a review of the instruments of public policy implementation. Particular attention is paid to the contribution of research studies in agricultural policy formation and accomplishment.

769 (669) Seminar on Agriculture and Economic Planning Models. Spring term. Credit three hours. Prerequisite: basic macroeconomics and quantitative methods. T 12:20–2:15. J. W. Mellor and M. S. Mudahar.
The seminar will deal with planning models as applied to less developed economies and will emphasize the interaction between the agricultural and the nonagricultural sectors. The course will begin with discussion of one sector models of the Harrod-Domar type, proceed to deal with the labor surplus models such as the Lewis, the Fei-Ranis, and the Jorgensen models and then to the multisectoral models of the linear programming type. Finally, it will examine the models in the light of various questions related to planning

such as balanced vs. unbalanced growth, choice of techniques, foreign trade, etc.

Public Policy

Attention is directed to course offerings in the Departments of Economics, Government, City and Regional Planning, Natural Resources, Civil Engineering, Consumer Economics and Public Policy, and the School of Business and Public Administration.

150 The Economics of Agricultural Geography. Fall term. Credit four hours. Lectures, M W F 11:15. Discussion, T W Th or F 2:30–4:25. D. G. Sisler.
The economics and geography of the world's agriculture, providing a basis for understanding past development and future changes in agriculture. Elementary economic principles, historical development, physical geography, and population growth are studied in their relation to agricultural development and the economic problems of farmers. Particular emphasis is placed upon study of the agriculture of various farming regions of the United States, their economic problems, and competitive situation.

230 Local Government. Fall term. Credit three hours. S-U grades optional. Lectures, T Th 9:05. Discussion, T 2:30–4:25. E. A. Lutz.
Government in the United States with emphasis upon examination, analysis, and resolution of public issues confronting leadership in localities of New York. Government organization, administration, functions, and finance are discussed in this context.

332 Economics of the Public Sector. Fall term. Credit three hours. Suggested prerequisite: Economics 102 or consent of instructor. M W F 11:15. H. P. Mapp.
Application of economic concepts to an evaluation of the structure and performance of the private and public sectors of the economy. Attention will be focused on the financing of federal, state and local public programs, such as education, health, public works and welfare, and the effects of alternative taxes on the allocation of resources and the distribution of income. Emphasis will also be placed on evaluating the benefits and costs of alternative public programs. A number of special lectures and class exercises will focus on current public policy issues, such as the economics of the property tax, environmental protection, the negative income tax, promotion of local economic development, land use regulation, revenue sharing, or other topics of current interest in the public sector.

350 Evaluating Environmental Quality. Spring term. Credit three hours. Primarily for juniors and seniors. T Th 10:10–11:30. L. D. Chapman.
A lecture-discussion course viewing means of reaching decisions on environmental questions. Subjects to be discussed are: concepts of social value and benefit-cost analysis, determination of degrees of importance of environmental problems, naturalistic methods of evaluation such as photography and essays, definitions of environmental quality, and questions of political economy. The class will make two or more field trips. A paper or some other project of value to the class is expected from each student along with substantial student participation. Class size is restricted. Permission to enroll may be obtained before or during the first week of classes.

351 Agricultural Policy. Fall term. Credit three hours. S-U grades optional. Two lectures plus one discussion section each week. Lectures, T Th 9:05. Discussion sections, Th 11:15 or 1:25, F 10:10. K. L. Robinson.
A review of the history of public policies affecting agriculture in the United States and an analysis of the economic effects of alternative farm policies or programs, either proposed or adopted. Among the topics discussed are farm price support and surplus disposal programs, trade policies affecting agriculture, alternative measures to alleviate rural poverty, and farm politics.

450 Resource Economics. Fall term. Credit three hours. Suggested prerequisite: Conservation 201 and Agricultural Economics 350 or consent of the instructor. Lectures, T Th 10:10. Discussion, T 1:25–3:20 and as arranged. D. J. Allee.
A review of the application of economic and political science concepts to problems in the use of natural resources including, but not restricted to, water, land, forests, and fisheries, with emphasis on the public management of the environment. Attention will be given to concepts of regional growth, the impact of urban growth, and public decision making in the resources area.

452 Regional Agricultural Development. Spring term. Credit four hours. Lecture, M W F 9:05. Discussion and field trips, Th or F 2–4:25. H. E. Conklin.
Practical procedures for appraising agricultural development potentials and generating suggestions for agricultural development programs in regions smaller than nations. Treats physical, biological, economic, social, and political aspects from a point of view that is intermediate between the micro and macro levels traditionally recognized in economics. Examples are drawn from United States and foreign areas. Laboratory and field trips provide opportunities for practice and observation.

637 Administration of Public Agricultural Programs. Spring term. Credit two hours. S-U grades optional. Primarily for graduate students. Undergraduate registration by per-

mission of the instructor. F 2:30–4:25. E. A. Lutz.
An examination of government organizations for administering and financing public agricultural programs; a study of some problems of administration and finance, including organization of agencies, management of personnel, budgetary management, interagency relationships (national, state, and local), and relationships among national, state, and local levels of government.

650 (550) Economic Analysis of Public Investment. Spring term. Credit four hours. Primarily for graduate students, but open to seniors. Prerequisite: Economics 311 or 511, or consent of instructor. T Th 9:05–11. R. J. Kalter.
The application of economic theory and analysis to the governmental decision making, budgeting and expenditures process with emphasis on the welfare criteria of economic efficiency and income distribution. Techniques of benefit-cost analysis, equity analysis, and systems analysis will be stressed. Discount rates, benefit estimation, externalities, multipliers, risk and uncertainty, and social welfare functions will be covered. Attention will be also focused on issues of cost sharing and reimbursement, and the way and means of intergovernmental payments.

652 (552) Special Problems in Land Economics. Fall or spring term. Credit one or more hours. Open only to graduate students. Prerequisite: permission of the instructor. D. J. Allee and H. E. Conklin.
Special work on any subject in the field of land economics that is of particular interest to the student.

750 (650) Workshop on Resource Economics. Fall term. Credit variable, two to six hours. Open only to graduate students. Prerequisite: 650 or consent of instructor. T 2:30–4:25. R. J. Kalter and other staff.
The application of economic theory and analysis to governmental decision making with emphasis upon graduate students' research.

751 (651) Seminar on Agricultural Policy. Spring term. Credit two hours. S-U grades optional. Open only to graduate students. M 1:25–3:20. K. L. Robinson.
A discussion of agricultural trade, price, and income-support policies and techniques appropriate to the analysis of policy issues.

752 (652) Readings in Philosophy. Spring term. Credit three hours. Open only to Ph.D. candidates. S 9:05–12. H. E. Conklin.
Readings are selected for their relevance to research in agricultural economics and are chosen from among books such as *Structure of Scientific Revolutions, The Theory of Experimental Inference, The Nerves of Government, The Structure of Economic Science, Economic Philosophy,* and *Probability Statistics and Truth.*

Quantitative Methods

Attention is directed to related courses in Economics, Economic and Social Statistics (ILR), Industrial Engineering and Operations Research, Mathematics, and Statistics and Biometry; selected courses particularly relevant to agricultural economics are dual listed.

310 Introductory Statistics. Fall term. Credit three hours. Prerequisite: Orientation 110 or equivalent level of algebra. Lectures, T Th 11:15. Discussions, M T or W 1:25. Computing period in the afternoon or morning following the discussion, M T W 2:30, T W Th 10:10. T. D. Mount.
An introduction to statistical inference including probability concepts, estimation, hypothesis testing, simple linear regression, and one-way analysis of variance.

Statistics II (Industrial and Labor Relations 311). Fall term. Credit four hours. Prerequisite: one term of applied statistics or permission of the instructor.
An intermediate nonmathematical statistics course emphasizing the concepts associated with statistical methods. Topics include estimation and tests of hypotheses with applications involving means, variances, correlation coefficients, and an introduction to nonparametric methods, analysis of variance, and multiple regression.

Introduction to Computer Uses in Data Analysis (Rural Sociology 314). Fall term. Credit three hours. S-U grades optional. Prerequisite: one term of statistics or permission of instructor. T Th 11:15. Laboratory arranged. D. E. Moore.
An introduction to computing. Open to all students with interests in analyzing data; preparation and description of data; preparing and running computer programs using the FORTRAN language; computer attributes and applications, library programs and associated facilities.

412 Introduction to Quantitative Methods. Fall term. Credit three hours. Prerequisite: 310 and 324 recommended. Lecture, T Th 10:10. Discussion, Th or F 1:25–3:20. D. G. Barton.
An introduction to quantitative decision techniques with heavy emphasis on linear programming and related mathematical programming techniques. Other topics include game theory, decision theory, and inventory theory. Numerous applications to problems in agriculture and business management. Primarily for seniors and M.S. candidates.

Matrix Algebra (Statistics and Biometry 417). Fall term. Credit three hours. Prerequisite: the equivalent of one year of college algebra. Lecture, M W F 8. S. R. Searle.
Basic matrix algebra with applications in biology, business, economics, and statistics.

Arithmetic procedures and other matrix operations; determinants, rank and linear independence, latent roots and vectors, solving linear equations, generalized inverses, direct sums and products. Use of matrices in regression analysis and linear statistical models.

710 (510) Econometrics I. Spring term. Credit four hours. Prerequisite: ILR 311 (Statistics II) or equivalent; Statistics and Biometry 417 or equivalent suggested. Lectures: T Th 2:30–4:25. W. G. Tomek.
A comprehensive treatment of the classical regression model with selected extensions, including an introduction to simultaneous equations models and estimation methods, about at the level of *Econometric Methods* by J. Johnston. Emphasis is placed on correct applications of econometric tools with most examples drawn from microeconomic problems in agriculture.

711 (511) Econometrics II. Fall term. Credit four hours. Prerequisite: 710 or equivalent. Statistics and Biometry 417 suggested. Lecture, M W 3:35–5. T. D. Mount.
An extension of multiple regression analysis to include generalized least squares, analysis of covariance models, and stochastic parameter models. Applications emphasize microeconomic problems using single equation techniques, for example, distributed lag models in investment theory. Additional topics include principal components, factor analysis, and probit analysis.

712 (512) Quantitative Methods I. Fall term. Credit three hours. Course 417 or equivalent suggested though not required. M W F 11:15. R. N. Boisvert.
Comprehensive treatment of linear programming and its extensions, including postoptimality analysis and the transportation model. Special topics in integer and nonlinear programming, including spatial equilibrium and risk programming models are also covered. Input-output models are treated in detail. Applications are made to problems in agricultural, resource and regional economic problems.

713 (513) Quantitative Methods II. Spring term. Credit three hours. Prerequisite: 712, an introduction to probability theory is useful. M W F 10:10. R. B. How.
Probabilistic models and methods including queuing theory, inventory theory, Markov chains, dynamic programming, and simulation. Applications to a variety of problems in agricultural economics and business management are used to explore and evaluate the techniques.

[714 (610) Econometric Models. Spring term. Credit three hours. Prerequisite: Course 710 or equivalent; course 711 preferred. Time and place arranged. W. G. Tomek and T. D. Mount. Offered in alternate years. Not offered in spring, 1975.
Theoretical and practical aspects of specifying and evaluating econometric models. Selected empirical studies in agricultural economics serve as the basis for discussion. This course provides depth and experience in model construction beyond that of courses 710 and 711.]

717 (507) Introduction to Research in Agricultural Economics. Fall term. Credit two hours. Open to graduate students only. W 1:25–3:20. Offered in alternate years. Staff.
A discussion of the research process, scientific method and its applications in agricultural economics. Perspective is provided by reviewing a variety of recent publications summarizing research efforts in this field. Topics discussed include inductive and deductive methods, development of hypotheses, methods of testing alternatives, sources and methods of obtaining data, sampling and analytical procedures. Survey procedure and questionnaire construction are reviewed.

Other

380 (380H) Independent Honors Research in Social Science. Throughout the year. Credit one to six hours. Open only to candidates who have met the requirements for the Honors Program. A maximum of six credits may be earned in the Honors Program.

499 Undergraduate Research. Fall and spring terms. Credit one to four hours depending upon the problem undertaken and the extent and quality of work done. S-U grading optional. A student desiring to register must attach to preregistration material, the written permission of the staff member who will supervise the work and assign the grade. Open to seniors with quality point averages of 2.7 or higher. Designed to afford opportunities for outstanding undergraduates to carry out independent studies of suitable problems under appropriate supervision.

Agricultural Engineering

101 (106) Mechanical Drawing. Fall term. Credit three hours. Lectures, T Th 8. Laboratory, W 1:25–4:25. H. A. Longhouse.
Graphic presentation, including lettering, use of instruments; orthographic projection of multiview drawings including sections, auxiliaries, plans and elevations; pictorial drawing, graphs and charts; elementary descriptive geometry; and the practical applications of these principles to simple problems. Both machine drawing and architectural drawing conventions and practices are discussed and employed in the solving of drawing problems.

103 Basics of Electronic Computation. Spring term. Credit one hour. Discussion-laboratory, two hours. M or Th 2:30–4:25. Limit

twenty students each section. L. D. Albright. Directed exercise in using electronic calculators for solving selected agricultural management and production problems. Several types of electronic calculators used. Flow charting techniques for problem solutions emphasized. Digital computer programming languages will not be taught. The course goal is to teach the use of machines which can take the tedium out of doing arithmetic computations.

110 (205) Farm Metal Work. Fall or spring term. Credit two hours. Lecture, Th 9:05. Laboratories, 1:25–4:25. One laboratory section includes metal lathe work. This section is offered on Monday in the fall term and in the spring term; it is limited to twenty-four students. The other laboratory, which includes general shop skills, is limited to twenty students. It is offered on Tuesday in the fall term, and on either Tuesday or Thursday in the spring term. F. G. Lechner.
Instruction and practice in fundamentals of electric arc welding, oxyacetylene welding, sheet metal work, pipe fitting, hot and cold metal work, and metal lathe work as they apply to farm shop work for both repair and construction jobs.

131 (104) Elements of House Design. Spring term. Credit three hours. Lectures, T Th 10:10. Riley-Robb 125. Recitation period, F 11:15 or 12:20. Laboratories (limited to twenty-five students each section), T W or Th 1:25–4. R. D. Black.
An introduction to design in agricultural engineering. The basic principles of planning and design of buildings and systems used for human habitation, with emphasis on the single family home. Construction, water and waste water systems, electrical wiring, lighting, heating, ventilation and refrigeration will be covered.

132 (204) Farm Carpentry. Fall term. Credit two hours. Lecture, T 9:05. Laboratories limited to fifteen students each section. Laboratory, T W or Th 1:25–4:25. F. G. Lechner.
Instruction and laboratory practice in basic farm carpentry, including concrete work, building construction, use of carpentry tools (both power and hand), tool fitting, and painting. Each student is required to plan and construct an approved carpentry project. Indoor furniture projects are not acceptable.

151 (152) Introduction to Agricultural Engineering Measurements and Graphics. Fall term. Credit one to three hours. Prerequisite: one term of calculus or concurrent registration. Lecture-laboratory T F 1:25–4:25. H. A. Longhouse.
The subject will be presented in modular form. Module I, T laboratory, will consist of the introduction to engineering measurements to graphics and the basics of PL/C. Module II, F laboratory, will consist of basics of surveying measurements. Both Modules I and II will be completed during the first nine weeks of the semester, and each will receive one credit. Module III, T laboratory, will enable the student to apply the measurement principles and computer skill to a typical engineering problem. Module IV, F laboratory, will enable the student to apply surveying knowledge and skill to an applied surveying problem. Both Modules III and IV will start at the tenth week and continue to the end of instruction. Each will receive one-half credit.

152 (153) Engineering Measurements and Graphics. Spring term. Credit one to three hours. Prerequisite: 151 or consent of instructor. Lecture–laboratory T F 1:25–4:25. W. W. Gunkel.
The subject will be presented in modular form. Module I, T Laboratory, will consist of engineering measurements, graphics, and PL/C. Module II, F laboratory, will consist of graphics including work on machine drawings, intersections, developments, descriptive geometry and use of conventional practices and symbols. Both Modules I and II will be completed during the first nine weeks of the semester and each will receive one credit. Module III, T laboratory, will enable the student to apply the measurement principles and computer skill to a typical engineering problem. Module IV, F laboratory, will enable the student to apply his graphic skills to selected problems. Both Modules III and IV will start at the tenth week and continue to the end of instruction. Each will receive one-half credit.

221 (222) Plane Surveying. Fall term. Credit three hours. S-U grades optional. Lectures, T Th 11:15. Laboratory, M T or W 1:25–4:25. Laboratory limited to twenty-four students each section. R. D. Black.
An introduction to plane surveying. Use and care of equipment is stressed, using field problems related to construction and mapping.

310 (305) Advanced Farm Metal Work. Fall term. Credit one hour. Machine shop instruction. Spring term. Credit one or two hours. Advanced welding and metal projects. Spring term prerequisite: 110, its equivalent, or permission of instructor. Laboratory, one credit, F 1:25–4; for two credits, one additional 2½ hour laboratory to be arranged. F. G. Lechner.

311 Farm Machinery. Spring term. Credit three hours. S-U grades optional. Not open to freshmen. Lecture, T Th 11:15. One recitation–laboratory each week, T W or Th 1:25–4:25. Limited to fifteen students each laboratory section. W. F. Millier.
A study of the operating principles, use, selection, and methods of estimating costs of owning and operating farm machines. The laboratory work will include practice in the

calibration of planting, fertilizing and pesticide application machinery, plus study of the functional characteristics of agricultural machines and machine components.

312 Power for Agricultural Operations. Fall term. Credit three hours. Prerequisites: 131 (104), Physics 102, or the equivalent. Lecture audio-visual-tutorial, M T W Th F 8–5. Laboratory T W or Th 1:25–4:25. W. F. Millier.
A study of the use of power in agriculture, with emphasis on the principles of operation and adjustment of internal combustion engines and their use in farm tractors. Some of the topics covered are: power utilization in the United States and world agriculture, Nebraska Tractor Tests, tractor stability and traction, economics of power unit selection, and human factors in tractor design.

[315 (313) Electricity on the Farm. Spring term. Credit three hours. Offered in alternate years. Prerequisite: 131 or Physics 102 or the equivalent. Lectures, T Th 10:10. Laboratory, T or Th 1:25–4:25. Instructor to be assigned. Not offered in 1974–75.
The application of electricity for light, heat, and power on farms, with emphasis on the principles of operation, selection, and installation of electrical equipment for the farmstead.]

321 Soil and Water Conservation. Fall term. Credit two hours. S-U grades optional. Must be taken with Agronomy 321. Prerequisite: Agronomy 200 or equivalent. Lecture, F 8. Laboratory, M or T 1:25–4:25. Additional laboratories will be offered if enrollment requires. G. Levine.
A study of the principles and practices used in the solution of soil and water conservation problems. Both farm and nonfarm problems are explored. Engineering aspects of erosion control, water management and storage, drainage, and irrigation receive primary consideration.

325 (421) Introduction to Environmental Pollution. Spring term. Credit three hours. S-U grades optional. M W 11:15. One hour discussion each week. Time to be arranged. D. C. Ludington.
A general course dealing with impairment of the environment by the wastes of man. The cause and effects of air, water, and soil pollution will be discussed. Fundamental factors underlying waste production, abatement, treatment, and control will be included. A selected number of wastes from urban, rural, and industrial areas will be used to illustrate the factors.

326 Agricultural Practices and Environmental Pollution. Spring term. Credit two hours. Prerequisite: 325 or permission of instructor. Lecture-recitation, F 1:25–3:15. D. C. Ludington.
Agricultural practices will be studied with regard to maintaining and improving environmental quality. Subjects will include alternatives for managing wastes associated with animal production, use of inorganic fertilizers and pesticides, conservation of soil and water, and rural domestic waste disposal. Pollution of water and air—aesthetic aspects and legal restraints will be emphasized. Guest lecturers will be used.

331 (233) Farmstead Production Systems. Fall term. Credit three hours. S-U grades optional. Lecture, M W F 8. R. T. Lorenzen.
A study of the facilities and equipment associated with agricultural production on the farmstead, with emphasis on buildings from the viewpoint of structural, environmental, operational, and biointrinsic design.

332 (234) Farmstead Systems Laboratory. Fall term. Credit two hours. Limited to 15 students per section. Open only to students who are currently taking or have previously taken 331. Drawing 101, Engineering Measurements and Graphics 152. Laboratory, Th or F 1:25–4:25. (Friday section open only when numbers require.) R. T. Lorenzen.
Practice in planning of farmstead production facilities including structural design, insulation, ventilation, and materials handling. Studies of wood, concrete, and other structural materials.

400 (401) Special Problems in Agricultural Engineering. Fall or spring term. Credit one or more hours. Normally reserved for seniors in upper two-fifths of class; undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. Prerequisite: adequate ability and training for the work proposed. Staff.
Special work in any area of agricultural engineering on problems under investigation by the department or of special interest to the student, provided in the latter case, that adequate facilities can be obtained.

401 (450) Special Topics in Agricultural Engineering. Fall term. Credit one hour. S-U grades optional. Open only to seniors. T 12:20. W. W. Gunkel.
Presentation and discussion of the opportunities, qualifications, and responsibilities for positions of service in the various fields of agricultural engineering.

415 (410) Physical Analysis of Plant and Animal Materials. Spring term. Credit two hours. Prerequisite: one semester of calculus. Two lectures. Time to be arranged. G. E. Rehkugler.
A study and analysis of the physical properties of plant and animal materials. The first part of the course will deal with the definition of pertinent physical properties and development of the meaning of a physical property. The morphology of plant and animal materials will be

related to problems of defining physical properties. Specifically, material product geometry will be examined and the influence of forces on behavior of materials will be studied. Physical properties of plant and animal materials will be related to material and manipulative forces applied in growth, harvesting, processing, and handling. The deformation and flow of these materials will be modeled. Interpretation of physical properties of plant and animal materials will be used in defining texture of food materials and mechanical damage to plant products.

416 (411) Laboratory Practice in Physical Analysis. Spring term. Credit one hour. Prerequisite: one semester of calculus. One laboratory or recitation each week. Laboratories and recitations will be offered in alternate weeks. Time to be arranged. G. E. Rehkugler. Laboratory component of course 415 (410). Course 416 (411) may be taken without 415 (410) by permission of the instructor. Laboratory practice will be in the physical analysis of plant and animal materials.

450 Introduction to Analog Computation. Fall term. Credit two hours. Lecture T 11:15. Laboratory T or Th 2:30–4:25. Enrollment limited. R. B. Furry.
Fundamentals of analog computing with elementary examples of applications from biological and physical systems. Includes basic computing elements, analog programming, scaling, and computer operation. An attempt will be made to permit students to work on a problem related to their own area of interest. A basic knowledge of differential equations is required.

461 Agricultural Machinery Design. Spring term. Credit three hours. Offered in alternate years. Prerequisite: mechanical design and analysis. Lectures, T Th 10:10. Laboratory, Th 1:25–4:25. Offered in alternate years. W. W. Gunkel.
The principles of design and development of agricultural machines to meet functional requirements. Emphasis is given to computer-aided analysis and design, stress analysis, selection of construction materials, and testing procedures involved in agricultural machine development. Engineering creativity and agricultural machine systems are also stressed.

[462 Agricultural Power. Fall term. Credit three hours. Offered in alternate years. Prerequisite: engineering mechanics (dynamics), or equivalent. Two lectures, one laboratory. Time to be arranged. G. E. Rehkugler. Not offered in 1974–75.
Utilization of internal combustion engine energy and other forms of energy in agriculture. Basic theory, analysis, and testing of internal combustion engines for use in farm tractors and other agricultural power applications. Specific study of tractor transmissions, Nebraska Tractor Tests, and soil mechanics related to traction and vehicle mobility. Economics and human factors in power use and application will be considered.]

465 (463) Processing and Handling Systems for Agricultural Materials. Spring term. Credit three hours. Prerequisite: 450. Offered in alternate years. Lectures, T Th 11:15. Laboratory T or W 2:30–4:25. R. B. Furry.
Processes such as size reduction, separation, metering, and drying will be studied. Psychrometrics, fluid flow measurement, and an introduction to dimensional analysis and controls for agricultural applications are included. Problem solutions will employ both the analog and digital computers. It is preferred that the student know how to write programs to utilize the digital computer prior to enrolling in the course.

[471 Soil and Water Engineering. Fall term. Credit three hours. Offered in alternate years. Prerequisite: fluid mechanics or hydraulics and soils, or concurrent registration; farm management recommended. Lectures, T Th 9:05. Discussion-laboratory, Th 1:25–4:25. R. D. Black. Not offered in 1974–75.
The application of engineering principles to problems of soil and water management. Design and construction of drainage, irrigation and erosion control systems, small reservoirs, and earth embankments will be covered.]

475 Systems Models for Environmental Quality Control. Spring term. Credit three hours. Prerequisite: one year of college mathematics. Lectures, M W F 1:25. Instructor to be assigned.
Introduction to the use of systems analysis techniques in the study of environmental quality problems. The course will emphasize the role of mathematical modeling as a technique for identifying alternative means of satisfying environmental quality objectives. The techniques of simulation and linear and dynamic programming will be applied to such areas as water quality control, solid-waste management, air pollution, control and agricultural wastes. Students will be encouraged to select course projects from their fields of interest.

[481 Agricultural Structures Design. Spring term. Credit two hours. Offered in alternate years. Prerequisite: structural engineering. One lecture and one recitation-laboratory each week. Time to be arranged. N. R. Scott. Not offered in 1974–75.
Application of basic structural concepts to design of agricultural structures. Emphasis on wood structures, including design of trusses, rigid frames, prefabricated panels, and columns. Design of reinforced concrete members and steel members. Economic considerations are presented also.]

[482 Environmental Control for Animals and Plants. Spring term. Credit two hours. Offered in alternate years. Prerequisite: thermodynamics. One lecture and one recitation-laboratory each week. Time to be arranged. N. R. Scott. Not offered in 1974–75.
Study of thermal interchanges between animals, (including man) and plants with the environment. Understanding of physiological principles affecting thermal comfort and health. Ventilation, air conditioning, psychrometrics, insulation, condensation control, solar energy, and weather phenomena.]

491 Highway Engineering. Fall term. Credit three hours. Prerequisite: consent of instructor. Lectures, W F 12:20. Laboratory M 1:25–4:25. L. H. Irwin.
Study of economic considerations in road improvement; planning and programming; road location and geometric design; traffic engineering; engineering soil characteristics and classification; design of roadbed thickness; drainage; stabilization methods and materials; wearing surfaces. Emphasis is on secondary roads.

492 Bituminous Materials and Pavement Design. Offered upon sufficient demand, usually in spring term. Credit three hours. Lectures, W F 12:20. Laboratory M 1:25–4:25. L. H. Irwin.
Properties of asphalts, aggregates, and bituminous mixtures; bituminous mixture design; pavement construction. Seal coat and surface treatment design and construction. Pavement maintenance. Flexible pavement design methods; rigid pavement design methods.

501–502 MPS Project. Fall and spring terms. Total credit up to six hours. Time to be arranged. Staff.
Comprehensive project utilizing applied problems pertinent to agricultural engineering. Required of each MPS candidate in the field.

551–552 Agricultural Engineering Project. Fall and spring term. Total credit six hours. Required for M. Eng. degree. G. E. Rehkugler and staff.
Comprehensive design projects utilizing real engineering problems. Emphasis on formulation of alternate design proposals, including economics and nontechnical factors, and complete design of the best alternative.

651 (501) Similitude Methodology. Spring term. Credit three hours. Two lectures, one laboratory. Time to be arranged. R. B. Furry.
Similitude methodology, including the use of dimensional analysis to develop general equations to define physical phenomena; model theory; distorted models; and analogies; with an introduction to a variety of applications in engineering. Problem solutions will employ both analog and digital computers. It is preferred that the student know how to write programs to utilize the digital computer prior to enrolling in the course.

652 (502) Instrumentation. Spring term. Credit three hours. Prerequisite: consent of instructor. Two lectures, one laboratory. Time to be arranged. N. R. Scott and staff.
Emphasis is on the application of instrumentation concepts and systems to physical and biological measurements. Characteristics of instruments, application of operational amplifiers and transistors for signal conditioning and interfacing, shielding and grounding; transducers for measurement of force, pressure, displacement, velocity, acceleration, temperature, light, and flow; and data acquisition systems, including telemetry, are considered.

675 (505) Solid Waste Management. Spring term. Credit three hours. Given in alternate years upon sufficient demand. Prerequisite: permission of instructor. M F 1:25–3. R. C. Loehr or W. J. Jewell.
Study of municipal, industrial, and agricultural solid waste. Emphasis on waste characteristics, method of treatment and disposal, and interrelationship with air, water, and land environment. Discussion of economic and political aspects. Intended primarily for graduate students but open to qualified undergraduates.

676 (506) Industrial Waste Management. Spring term. Credit three hours. Given upon sufficient demand. Prerequisite: permission of the instructor. Time to be arranged. R. C. Loehr or W. J. Jewell.
Legal aspects, assimilatory capacity of receiving waters, waste sampling and analysis, treatment processes, waste reduction possibilities, waste quantity and quality, reuse and recovery, joint industry-municipal treatment of wastes, sewerage, service charges, case studies. Emphasis is on liquid industrial wastes. Intended primarily for graduate students but open to qualified undergraduates.

677 (507) Treatment and Disposal of Agricultural Wastes. Spring term. Credit three hours. Prerequisite: permission of the instructor. Time to be arranged. R. C. Loehr or W. J. Jewell.
Emphasis is on the causes of agricultural waste problems and on the fundamentals and application of possible treatment and disposal practices to control the problems. The course is aimed at having the students understand how to make decisions about selecting and utilizing appropriate agricultural waste management processes and systems, as well as how to design and operate the systems. Aerobic and anaerobic processes, nutrient control, waste utilization, and land disposal are included. The students will apply these and other concepts to the management of wastes from specific animal

and crop production and food processing operations. Integration of feasible waste management methods into agricultural production constitutes a major part of the course.

678 (510) Environmental Quality Management for Agro-Ecosystems. Fall term. Credit three hours. Prerequisite: some knowledge of linear programming and some knowledge of probability, or permission of the instructors. Time to be arranged. D. A. Haith and C. A. Shoemaker.
The application of systems analysis and mathematical ecology to problems in ecosystem management and environmental quality. Topics to be considered will be selected from the following: pest control, fertilizer usage, eutrophication, agricultural waste, soil and water conservation, and public policy decisions affecting ecosystem management.

685 (504) Biological Engineering Analysis. Fall term. Credit four hours. Prerequisite: consent of instructor, or Engineering IAA351. M W F 9:05. J. R. Cooke.
Engineering problem-solving strategies and techniques will be explored. The student will solve several representative engineering problems which inherently involve biological properties. The mathematical modeling will emphasize problem formulation and interpretation of results. The student's knowledge of fundamental principles will be extensively utilized. Principles of feedback control theory will be applied to biological systems.

700 (601) General Seminar. Fall and spring term. M 12:20.
Presentation and discussion of research and special developments in agricultural engineering and other fields.

750 Orientation for Research. Fall term. Credit one hour. Time to be arranged. R. B. Furry.
Introduction of newly joining graduate students to departmental research policy, programs, methodology, resources, and candidate responsibilities and opportunities.

761 (602) Power and Machinery Seminar. Spring term. Credit one hour. S-U grades only. Prerequisite: graduate status and permission of the instructor. Time to be arranged. Staff.
Study and discussions of research and new developments in agricultural power and machinery.

771 (603) Soils and Water Engineering Seminar. Spring term. Credit up to three hours. S-U grades only. Prerequisite: graduate status and permission of instructor. Time to be arranged. Staff.
Study and discussion of research on selected topics in irrigation, drainage, erosion control, and agricultural hydrology.

775 (605) Agricultural Waste Management Seminar. Fall and spring terms. Credit one hour. S-U grades only. Prerequisite: graduate status and permission of instructor. F 2:30–4:00. Staff.
Management of agricultural waste, with emphasis on the physical, chemical, biological, economic, and aesthetic requirements will be studied and discussed.

781 (604) Agricultural Structures and Related Systems Seminar. Spring term. Credit one hour. S-U grades only. Prerequisite: graduate status and permission of instructor. Time to be arranged. Staff.
Farmstead production problems, with emphasis on biological, economic, environmental, and structural requirements.

785 (606) Biological Engineering Seminar. Spring term. Credit one hour. S-U grades only. Prerequisite: graduate status and permission of instructor. Time to be arranged. N. R. Scott and J. R. Cooke.
The interaction of engineering and biology will be examined, especially the environmental aspects of plant, animal, and human physiology in order to improve communications between engineers and biologists.

Agronomy

Soil Science

200 Nature and Properties of Soils. Fall or spring term. Credit four hours. S-U grades optional. Prerequisite: Chemistry 103, 107, 115, or Biological Science 131. Lectures, M W F 9:05. Laboratory, M T W Th or F 2–4:25 or T 8–10. Fall term, D. J. Lathwell. Spring term, T. W. Scott.
A comprehensive introduction to the field of

soil science with emphasis on scientific principles and their application in solutions of practical soil management problems.

301 Identification, Appraisal, and Geography of Soils. Fall term. Credit four hours. S-U grades optional. Prerequisite: course 200 or permission of the instructor. Lectures, M W F 10:10. Laboratory W 1:25–4:25. R. W. Arnold.
The soil as a natural body. Principles of identification and classification of geographic units of soil and interpretation of such units for applied objectives. Geography of major kinds of soil of North America in relation to environment and cultural patterns. Field practice characterizing, mapping, and interpreting geographical soil units.

310 Agronomy Literature. Fall term. Credit one hour. S-U grades optional. Prerequisite: 200 and 111 or their equivalents. Beginning graduate students accepted by permission of the instructor. Th 12:20. M. J. Wright.
In addition to study of research and extension periodicals reporting work in agronomy, each student will review several scientific articles and prepare an essay on an appropriate subject in agronomy.

321 Soil and Water Conservation. Fall term. Credit two hours. S-U grades optional. Prerequisite: 200 or equivalent; course 111 is recommended. Must be taken with Agricultural Engineering 321. M W 8. P. J. Zwerman.
A study of the principles and practices used in soil and water conservation. Agronomic aspects of erosion control, water management and storage, drainage, and irrigation receive primary consideration.

324 Soil Fertility Management. Fall term. Credit three hours. Prerequisite: 200 or permission of the instructor. M W F 9:05. D. R. Bouldin.
An integrated discussion of soil-plant relationships with emphasis on the soil as a medium for root growth, the soil as a source of mineral nutrients for plants, resources required for fertilizer production, and the role of fertilizers in crop production.

331 (431) Chemistry of Aquatic Plant Systems. Fall term. Credit three hours. Prerequisite: Biological Sciences 101–102 or 103–104, and Chemistry 107–108 or equivalent. Discussion, T Th 1:25–2:30. Laboratory, M to W 1:25–4:25. J. H. Peverly.
The chemistry and physiology of higher aquatic plants will be studied by following a sequence of reactions from the inorganic solid solution and gaseous phases of the environment to the cellular and subcellular levels of the plants. The student will be expected to apply the basic physical and chemical concepts presented to predict effects on aquatic plant growth and management. Some of these applications will be studied in the laboratory and also observed in field situations.

361 (461) Regional Agronomy Studies. Fall term. Credit four hours. Enrollment limited and must be approved by instructor in charge during preregistration. Prerequisite: 111 and 200 or equivalent and permission of the instructor. Discussion, two hours per week, F 12:20–2:15. Three-week field-study trip during August 1974. F. N. Swader.
Study of soils, crops, agricultural institutions, and industries of Northwestern United States. The purpose is to give breadth of understanding of the field of agronomy in relation to allied fields. During the summer field-study trip, each student will be required to keep complete notes of basic subject matter for seminars, discussions, and assignments during the fall semester. Round-trip transportation will be provided from Ithaca. Students must finance meals and lodging, costs of which will be held to a minimum.

401 Geography and Appraisal of Soils of the Tropics. Spring term. Credit three hours. S-U grades optional. Lectures, W F 12:20. Discussion, F 2:30–4:25. Staff on tropical soils.
Character, production potential, and management requirements of soils of tropical rain forests, tropical savannahs, tropical deserts, and tropical highlands, including soils under paddy culture. Emphasis is on soil properties associated with the principal kinds of soil and bases for their interpretation in terms of production potential and management requirements. Lectures are used to introduce principles whose applications are treated by problem solving, discussion, and independent study of the literature. Individuals who have not had the equivalent of course 200 will be expected to become familiar with elementary principles of soil on their own.

[403 Soil Organic Matter and Organic Soils. Fall term. Credit two hours. Offered in alternate years. Prerequisite: course 200. T Th 9:05. J. M. Duxbury. Not offered in 1974–75.
A study of the nature and properties of soil organic matter. Organic soils are treated as a special case of soil organic matter accumulation. Field trip to be arranged.]

404 Forest Soils. Fall term. Credit two hours. Prerequisite: 200. M or T 1:25–4:25. E. L. Stone. Each section limited to fifteen students.
Ecology of forest and wildland soils, including relationships to soil development, vegetation, and land use. First half of the course is based on local field trips and exercises that often will not allow return before 5 or 5:30 p.m.; second half consists of lectures and laboratory demonstrations.

405 Soil Clay Mineralogy. Fall term. Credit three hours. Given in alternate years. Pre-

requisite: 200 and one year each of college chemistry and physics, or consent of instructor. Lecture, T Th 9:05. Laboratory (Optional. One credit hour), W 2–4:25. R. M. Weaver.
A study of the minerals found in soils, with major emphasis on the structures, properties, and identification of the clay minerals. Topics will be related to the influence of clay minerals on physical and chemical properties of soils with special reference given to soils of the tropics.

[406 (306) Soil Microbiology (lectures). Spring term. Credit three hours. Offered in alternate years. Prerequisite: 200 or Microbiology 290. M W F 10:10. M. Alexander. Not offered in 1974–75.
A study of the major groups of soil microorganisms, their ecological interrelationships, and the biochemical functions of soil organisms.]

[407 (307) Soil Microbiology (laboratory). Spring term. Credit one hour. Offered in alternate years. Prerequisite: concurrent registration in 306. T 1:25–4:25. M. Alexander. Not offered in 1974–75.
Laboratory exercises concerned with the ecology and biochemical activities of soil microorganisms.]

410 Microbial Ecology. Spring term. Credit three hours. Given in alternate years. Prerequisite: an elementary course in some facet of microbiology. M W F 10:10. M. Alexander.
An introduction to the basic principles of microbial ecology. Attention is given to the behavior, activity, and interrelationships of bacteria, fungi, algae, and protozoa in natural ecosystems. (Also listed as Microbiology 492.)

450 Special Topics in Soil Science. Fall and spring terms. Credit one to six hours. S-U grades optional. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade.
The topics to be treated will be arranged at the beginning of each term for individual self-study or for group discussions. Time to be arranged. Staff.

470 Undergraduate Research in Soil Science. Fall and spring terms. Credit to be arranged. Written permission from the staff member who will supervise the work and assign the grade must be attached to preregistered material. Time to be arranged. Staff.
Independent research on current problems selected from any phase of soil science.

480 Management Systems for Tropical Soils. Fall term. Credit three hours. S-U grades optional. Prerequisite: 200 or 401 or equivalent, or permission of the instructor. Lectures, W F 8. Discussion and problem solving, W 2:30–4:25. Staff on tropical soils.
Physical, chemical, and biological bases for adapting soil management systems for crop production to the needs of important kinds of tropical soils. Emphasis is on combinations of practices for managing soil fertility, water, and tilth for food-crop production. Soils of contrasting properties and environments will be studied.

[506 (406) Use of Soil Information and Maps as Resource Inventories. Fall term. Credit two hours. S-U grades optional. Offered in alternate years. T Th 11:15. G. W. Olson. Not offered in 1974–75.
Principles, practices, and research techniques in interpreting soil information and maps for planning, developing, and using areas of land.]

602 (402) Chemical Methods of Soil Analysis. Spring term. Credit three hours. Prerequisite: 200 and Chemistry 236 or their equivalent. T Th 1:25–3:30. M. Peech.
Lectures and laboratory demonstrations designed to familiarize the student with different chemical techniques for studying soils.

603 (503) Morphology, Genesis, and Classification of Soils. Spring term. Credit three hours. Offered in alternate years. Prerequisite: graduate status or permission of the instructor. T Th S 10:10. R. W. Arnold.
Principles of soil classification, reactions and processes of soil genesis, and development and significance of major groups of soils of the world. One all-day field trip on a date to be arranged.

606 (506) Advanced Soil Microbiology. Fall term. Credit one hour. Only S-U grades for graduate students. Prerequisite: 406 or permission to register. T 12:20. M. Alexander.
Discussions of current topics in special areas of soil microbiology. Particular attention is given to biochemical problems in microbial ecology.

607 (507) Soil Physics, Lectures. Fall term. Credit three hours. Offered in alternate years. Prerequisite: 200 and one year of college physics or permission of the instructor. M W F 11:15. R. D. Miller.
A study of physical properties and processes of soil, with emphasis on basic principles.

608 (408) Soil Physics, Laboratory. Fall term. Credit two hours. Offered in alternate years. Sections limited to maximum of eight students or minimum of four. One lecture period each week to be arranged. Laboratory, Th 1:25–4:25, or as arranged. R. D. Miller.
Laboratory procedures and exercises in soil physics.

650 (550) Research Orientation and Perspective. S-U grades optional.
See Agronomy—Crop Science.

[701 (501) Soil Chemistry. Fall term. Credit three hours. Offered in alternate years. Prerequisite: 200 and a one-year course in introductory physical chemistry, or consent of the instructor. T Th S 10:10. M. Peech. Not offered in 1974–75.
Chemical composition and chemical properties of soils, with emphasis on ionic equilibria in soils.]

[724 (524) Soil Fertility, Advanced Course. Spring term. Credit three hours. Offered in alternate years. Prerequisite: graduate status, major or minor in agronomy or permission of instructor. T Th S 9:05. D. R. Bouldin. Not offered in 1974–75.
A study of selected topics in soil-plant fertilizer relationships with emphasis on concepts of soil fertility, interpretation of experimental data, and soil-fertilizer chemistry.]

760 (560) Graduate Research in Soil Science. Fall and spring terms. By arrangement. Not open to undergraduates. All members of the graduate Field.

790 (690) General Agronomy Seminar. Fall and spring terms. Without credit. Required of graduate students majoring or minoring in the department. Alternate weeks. T 4:30.

791 (691) Soil Science Seminar. Fall and spring terms. Without credit. Required of students whose major or minor subject is soil science. Time to be arranged.

Special Studies of Problems of Agriculture in the Tropics (International Agricultural Development 602).

Crop Science

111 Introduction to Crop Science. Fall or spring term. Credit four hours. Open to all classes beginning with first-semester freshmen. Lectures, M W F 10:10. Fall laboratory, M T W or Th 1:25–4:25; spring laboratory, T W Th or F 1:25–4:25. Fall term, R. L. Obendorf; spring term, R. F. Lucey.
Principles of field crop growth, development and maturation, species recognition, soil and climatic adaptations, liming and mineral nutrition, weed and pest control, cropping sequences, management systems, and crop improvement are considered. Feed crops for livestock and food and fiber crops including hay, silage, pasture, grain, protein and oil crops are emphasized. Field trips (one or two) to observe and study experimental methods and procedures and/or farm operations are held during laboratory periods until 5.

312 Feed Crops. Spring term. Credit four hours. Prerequisite: an introductory course in crop production. A course in livestock feeding is recommended. M W F 8. Discussion, T 9:05. G. W. Fick.
The production and management of crops used for livestock feed is considered in terms of establishment, growth, maintenance, harvesting, and preservation. Forage grasses, forage legumes, and corn are emphasized; and consideration is given to their value as livestock feed in terms of energy, protein, and other nutritional components.

315 Weed Science. Spring term. Credit three hours. Graduate students may register only by permission. Prerequisite: 111 and 200, Biological Sciences 103–104 or the equivalent. Prior or simultaneous courses in organic chemistry or plant physiology would be desirable. Lectures, T Th 8. Laboratory, M 2–4:25. W. B. Duke.
Principles of weed science are examined. Emphasis is given to (*a*) weed ecology; (*b*) chemistry of herbicides in relation to effects on plant growth; and (*c*) control of weeds in all crops. Laboratory covers identification of weeds and physiology of herbicide action.

361 (461) Regional Agronomy Studies. See Agronomy—Soil Science.

371 (471) Undergraduate Research in Crop Science. Fall and spring terms. Credit to be arranged. Written permission from the staff member who will supervise the work and assign the grade must be attached to preregistration material. Time to be arranged. Staff.
Independent research on current problems selected from any phase of crop science.

422 Tropical Agriculture. Spring term. Credit three hours. Prerequisite: a course covering elementary botany and permission of instructor. M W F 10:10. H. A. MacDonald.
Designed to provide some knowledge and understanding of the tropical environment and its agriculture. Topics covered include the agriculture, principal crops, cropping practices, and problems of the tropics and subtropics. Particular stress is given to (*a*) agricultural ecology; (*b*) agricultural patterns, traditions, and problems; (*c*) economic crops, their botany, adaptation, cultural requirement, improvement, management, protection, production, and use, and (*d*) resources, limitations, and opportunities for tropical agricultural development and improvement. Independent study in special areas of interest is encouraged and facilitated. Lectures supplemented by illustrations, demonstrations, and discussions.

613 (513) Crop Ecology. Fall term. Credit two hours. Offered in alternate years. Prerequisite: 111, 200, and Biological Sciences 240. Class meetings to be twice weekly for last ten weeks of semester for two hours per meeting. Times to be arranged. R. B. Musgrave.
A study of special techniques used to obtain

and analyze physiological data on crop plant responses to environmental conditions occurring in the field.

614 (514) Grasslands and Grassland Research. Fall term. Credit three hours. Offered in alternate years. Prerequisite: 111, 200, and Biological Sciences 240, or their equivalents, and permission of instructor to register. M W F 9:05. H. A. MacDonald.
A study of ecological factors underlying the development, maintenance, production, and management of different grassland types for various uses, and the principles and practices of grassland and forage crop investigations. Grassland species, types, and associations will be discussed in relation to adaptation, production, and use. Emphasis will be on research methods and techniques in the study of temperature, tropical and arid region, grasslands.

650 (550) Research Orientation and Perspective. Fall term. Credit two hours. S-U grades optional. T Th 10:10. Will not be offered for less than seven students. H. A. MacDonald.
Familiarizes students with the philosophy, organization, method, and conduct of research; and provides information and practice in planning, organizing, writing, and oral presentation of results. The latter part of the course will deal with the reporting of research progress and results in relation to graduate study, seminar presentation, and thesis preparation. Active student participation is required.

651 (451) Special Topics in Crop Science. Fall and spring terms. Credit one to six hours. S-U grades optional. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. Time to be arranged. Staff.
The topic to be treated will be arranged at the beginning of each term for individual self-study or for group discussions.

661 (561) Graduate Research in Crop Science. Fall, spring, and summer terms. By arrangement. Not open to undergraduates. All members of the graduate Field.

790 (690) General Agronomy Seminar. Without credit.
See Agronomy—Soil Science.

792 (692) Crop Science Seminar. Fall and spring terms. Without credit. Required of students whose major or minor subject is crop science. Time to be arranged.

Forages of the Tropics for Livestock Production (Animal Science 403).

Special Studies of Problems of Agriculture in the Tropics (International Agricultural Development 602).

Animal Sciences Program Area

Includes courses in the Department of Poultry Science and the Department of Animal Science.

100 Introductory Animal Science. Fall term. Credit three hours. S-U grades optional. Lectures, W F 10:10. Laboratory, T Th or F 2–4:25. J. M. Elliot.
Designed to acquaint the beginning student with the development, scope, economic importance, problems, and language of the livestock industry. All commercially important classes of farm animals are considered with emphasis on dairy cattle, beef cattle, sheep and swine. The place of the biological sciences in a rapidly changing animal agriculture is stressed. The intent is to give insight into opportunities in the field and to serve as an introduction to subsequent specialized courses.

105 Contemporary Perspectives of Animal Science. Spring term. Credit one hour. S-U grades optional. Prerequisite: an interest in animal science. T 1:25, W 10:10, W 12:20. Taught by the entire faculty of the Department of Animal Science.
A forum for students and faculty to discuss the contemporary and future role of animals in relation to the needs of man. Sections containing about 15 students will meet weekly with one faculty member. Informal discussion will be emphasized following short presentations by faculty and graduate students with special competence in the topic of the week.

230 (Poultry Sci. 100) Introduction to Poultry Science. Spring term. Credit three hours. Lecture, T Th 11:15. Laboratory, W 2–4:25. On the several days when there are field trips, a longer Wednesday session may be necessary. R. E. Austic.
Designed to acquaint the student with the scope of the poultry industry with emphasis on the principles of avian biology and their application in the various phases of poultry production.

241 Applied Livestock Selection and Meat Evaluation: Beef Cattle, Sheep, and Swine. Fall term. Credit two hours. Prerequisite: 100 or permission to register. Lecture and laboratory periods, W 2–4:25. J. I. Miller and G. H. Wellington.
Practical application of the various methods used in determining the utility value of market and breeding classes of meat animals and carcasses. Grading standards, meat quality and yield factors, breeding records, performance, and progeny tests are considered. A one-day field trip is taken to study market and consumer acceptability of meat products.

260 Beef Cattle. Spring term. Credit three hours. Prerequisite: 100 or permission to register. Lectures, T Th 10:10. Laboratory, M 2–4:25. J. I. Miller.
The management, feeding, breeding, selection, and marketing problems involved in the beef-cattle enterprise are emphasized. A one-day field trip is taken to study successful beef production methods.

265 Horses. Spring term. Credit two hours. Prerequisite: 100 or permission to register. Lecture, Th 9:05. Laboratory, Th 1:25–4:25. H. F. Hintz and J. E. Lowe.
Selection, management, feeding, breeding, training, and marketing of light horses.

[330 (Poultry Sci. 280) Poultry Farm Management. Fall term. Credit three hours. Offered in alternate years. Not open to freshmen. Lecture, T Th 10:10. Rice 101. Laboratory, W 2–4:25. G. H. Thacker. Not offered 1974–75.
Practical and business management problems of the commercial poultry farm and industry will be studied. Assigned farm studies. Field trips, one or more over-night, will be taken.]

365 Seminar on Horse Production. Fall term. Credit two hours. Prerequisite: 112, 220, 221, and 265, or equivalent. Enrollment limited to eighteen students. F 1:25–4. Discussion period to be arranged. H. F. Hintz; J. E. Lowe, and S. W. Sabin.
Discussion of the management of various types of horse enterprises such as the breeding farm, training stable, and riding stable. One all-day field trip will be taken.

370 Swine. Fall term. Credit three hours. Prerequisite: 100; 112, 220 and 221 also recommended. Lectures, T Th 11:15. Laboratory and discussion periods alternate M 1:25–4:25. The laboratory and discussion period is offered on alternate Mondays arranged so students can take 380 concurrently. W. G. Pond.
The characteristics of swine and their breeding, feeding, management, and selection. Laboratory and discussion periods are designed to give the student a practical knowledge of the pig as an animal and of commercial swine production practices.

380 Sheep. Fall term. Credit three hours. Prerequisite: 100; courses 112, 220, and 221 also recommended. Lectures, T Th 10:10. Laboratory and discussion periods alternate M 1:25–4:25. The laboratory is given on alternate Mondays arranged so students can take 370 concurrently. D. E. Hogue.
The breeding, feeding, management, and selection of sheep. Lectures and laboratory are designed to give the student a practical knowledge of sheep production as well as the scientific background for improved practices.

400 Livestock Production in Warm Climates. Spring term. Credit three hours. Prerequisite: 112, 220, and 221 or permission of the instructor. Lectures and discussions, T Th 10:10–12:05. R. E. McDowell.
Deals with factors inhibiting efficient livestock production and some of the potential roles animals can fulfill as sources of food, power, and fiber in the tropical areas of the world.

[403 Forages of the Tropics for Livestock Production. Spring term. Credit three hours. Prerequisite: a course in crop production and in livestock nutrition and permission of the instructor. Lectures, M Th 12:20. Discussion M 1:25. L. V. Crowder and others. Not offered 1974–75.
A review of the naturalized grasslands sown pastures and fodders of the tropics and their utilization for grazing and livestock feeding. Agronomic characteristics of grasses and legumes, pasture management, conduct of grazing trials, and systems of management for livestock will be considered. Nutritive value of tropical forages and digestibility studies are included.]

Poultry Hygiene and Disease (Veterinary 255). Fall term. Credit two hours. Offered in alternate years. Prerequisite: Biological Sciences 290 or 290A, and permission of the instructor. Th 2–4:25. Veterinary College. S. B. Hitchner.
The nature of the infectious and parasitic diseases of poultry and the principles of hygiene applicable to poultry farming for the prevention and control of diseases.

Health and Diseases of Animals (Veterinary 475). Spring term. Credit three hours. Not

open to first-year students or to those who have had no course in animal husbandry. Lectures, M W F 11:15. C. E. Hall.
The causes and the nature of the common diseases of livestock are discussed. Emphasis is placed on the prevention and control of animal diseases.

Special Studies on Problems of Livestock Production in the Tropics (International Agriculture 602).

Meats

290 Meat and Meat Products. Fall or spring term. Credit three hours. Lectures, T Th 9:05. Laboratory, fall term, M T or Th 1:25–4:25; spring term, M T or W 1:25–4:25. J. R. Stouffer.
The handling of red meat and poultry following slaughter. Composition, postmortem changes, and organoleptic changes of meat will be discussed. Also includes packaging, preservation, development of new products, and merchandising of meat, poultry, eggs, and fish. Field trips to commercial plants will be taken.

490 Science and Technology of Meat, and Eggs. Spring term. Credit three hours. Prerequisite: 290 or permission. Lecture, T Th 11:15. Laboratory, Th 1:25–4:25. G. H. Wellington and staff.
The character of muscle as a food, muscle structure, meat product formulations and production, methods for meat-product quality control, product testing, and improved meat packaging. The basic principles of meat preservation, processing, and meat-product development through laboratory demonstration and practice in the pilot meat plant in Morrison Hall.

Dairy Husbandry

250 Dairy Cattle. Fall term. Credit three hours. S-U grades optional. Lecture, T Th 10:10. Laboratory, M or Th 2–4:25. G. H. Schmidt.
Covers the trends in the industry, study of the breeds, factors in breeding and development of dairy cattle, milk secretion and milking methods, nutritive requirements of cows and feeding programs, calf raising systems, disease prevention, management, and record keeping systems.

251 Dairy Cattle Selection and Type Evaluation. Spring term. Credit three hours. Laboratory, W 1:25–5:30. One hour lecture to be arranged at the most convenient time possible. One Saturday trip. G. W. Trimberger.
Introduction to the selection and type evaluation of all breeds of dairy cattle. Emphasis on herd improvement through high production and conformation characteristics for practical type to achieve wearability for high lifetime production. Educational lectures, demonstrations, and practice sessions include planned trips to outstanding herds in the state.

350 Dairy Cattle Production and Management. Spring term. Credit three hours. Prerequisite: 112 and 220. Lectures, T Th 11:15. Laboratory, T 1:25–4:25. G. H. Schmidt; G. W. Trimberger.
Designed for students who have an extensive interest in dairy cattle production and management. Analysis of dairy cattle breeding, housing, and management systems; development of feeding systems for economical production; and study of the principles of milk secretion and milking procedures, including evaluation of milking systems. Consideration will be given to the application of modern technology in these areas including farm visits to observe this technology in operation.

352 Advanced Dairy Cattle Selection. Fall term. Credit three hours. Prerequisite: 251. Registration by permission. Practice hours to be arranged. G. W. Trimberger.
Intended primarily to give additional training in comparative judging to successful students of 251. Members of the class are selected to represent the institution in intercollegiate judging competitions.

Animal Breeding and Genetics

221 Introductory Animal Genetics. Spring term. Credit three hours. Prerequisite: One year of college biology. Lectures, T Th 12:20. Laboratory, W Th or F 2–4:25. R. L. Quaas.
Introduction to the breeding of large animals. Basic genetic principles, heritability of quantitative traits, estimation of breeding value, progeny testing, inbreeding, cross-breeding, lethal genes, genetic resistance to disease.

321 Seminar on Genetics of the Horse. Spring term. Credit one hour. Prerequisite: 265 or permission. Course 221 or Biological Sciences 281 recommended. Time to be arranged. L. D. Van Vleck and staff.
Discussion of genetics of the horse with special reference to inbreeding and selection for quantitative traits.

419 (Poultry Sci. 419) Animal Cytogenetics. Spring term. Credit three hours. Prerequisite: Genetics 281 or Animal Science 221, or the equivalent. Lecture, M W 10:10. Laboratory, M or T 2–4:25. Alternates with Cytogenetics 440. S. E. Bloom.
Deals with the causes and phenotypic effects of chromosomal aberrations in higher animals. The effects of chromosome abnormalities on embryo development, postnatal growth, and behavior are considered. Special attention is given to genetic, physiological and environmental variables that may cause meiotic and

mitotic abnormalities. Cytogenetic, cytochemical and cytophotometric techniques are discussed and demonstrated.

420 Quantitative Animal Genetics. Fall term. Credit three hours. Lecture, T Th 11:15. Laboratory, W or F 2–4:25. L. D. Van Vleck.
A consideration of the problems involved in the improvement of animals, especially farm animals, through the application of the theory of quantitative genetics with emphasis on the selection index.

421 Seminar in Animal Genetics. Fall term. Credit one hour. Must be taken concurrently with 420. Time to be arranged. L. D. Van Vleck and staff.
Sections will be arranged depending on interests of students to discuss application of principles of quantitative genetics and animal breeding to specific types of animals, e.g., dairy, meat, and horses.

422 Research Techniques in Quantitative Animal Genetics. Fall term. Credit one hour. Prerequisite: 420 (may be taken concurrently). Time to be arranged. L. D. Van Vleck.
An introduction to methods of research in quantitative genetics and animal breeding including estimation of heritability, repeatability, and genetic and phenotypic correlations.

430 Livestock Improvement through Artificial Breeding. Spring term. Credit four hours. Also open to upper classmen and graduate students. Prerequisites: 220, 221 or equivalent, and permission of instructor. Lecture, T 10:10. Recitation to be arranged. Laboratory, T and F 2–4:25. R. W. Bratton.
An extensive and intensive study of the artificial breeding industry and the physiological and genetic principles used to maximize improvement of the genetic traits of economic importance in farm livestock production. The laboratories will provide opportunity for students to obtain considerable individual experience in both the physiological and genetic techniques that are relevant to both the male and the female aspects of artificial breeding in all classes of large farm animals. Small laboratory animals will also be used. The course work requires a very high level of participation by the student.

520 Experimental Methods in Quantitative Genetics and Animal Breeding. Fall term. Credit three hours. Prerequisite: Statistics and Biometry 417, and either Statistics and Biometry 517, or a course in mathematical statistics. Time to be arranged. C. R. Henderson.
Estimation of genetic and environmental parameters required to design efficient selection programs. Particular emphasis is given to interpretation of experimental and survey data with unequal subclass numbers and to prediction of genetic progress resulting from alternative selection methods.

620 Seminar in Animal Breeding. Fall and spring term. Credit one hour. Open to graduate students with major or minor in animal breeding. Time to be arranged.

Animal Physiology

220 Animal Reproduction and Development. Fall term. Credit three hours. Prerequisite: A year of college biology or animal science. Limited to 36 students per laboratory section. Lectures, T Th 9:05. Demonstration and laboratory, M T W Th or F 2–4:25, or T 10:10–12:35, or W 12:20–2:30, or F 11:15–1:25. R. H. Foote.
An introduction to the comparative anatomy and physiology of reproduction of farm animals. The life cycle from fertilization of ova through development and growth of sexually mature individuals will be studied, with emphasis on physiological mechanisms involved, relevant genetic control, and the application to fertility regulation and improvement of animal populations. An audio-tutorial laboratory is available for independent study and to prepare for laboratory experiments.

427 Fundamentals of Endocrinology. Fall term. Credit four hours. Prerequisite: a course in human or veterinary physiology, or by permission. Lecture, T Th S 10:10. Laboratory, T or Th 1:25–4:25. W. Hansel.
The physiology of the endocrine glands and the roles played by each hormone in the regulation of normal body processes. The laboratory work consists of a series of experiments designed to illustrate the basic principles of endocrinology.

428 (Poultry Sci. 425) Comparative Physiology of Reproduction of Vertebrates. Spring term. Credit two hours. Prerequisite: Animal Science 427 or consent of instructor. Lecture, W F 1:10. A. van Tienhoven.
Sex and its manifestations. Neuroendocrinology, endocrinology of reproduction, sexual behavior, gametogenesis, fertilization, embryonic development, oviparity, viviparity, environment and reproduction, nutrition and reproduction.

429 (Poultry Sci. 425A) Reproductive Physiology of Vertebrates (Laboratory). Spring term. Credit two hours. Prerequisite: Animal Science 428 or co-registration in Animal Science 428 or consent of instructor. Time to be arranged. Organization meeting Friday 2:30. A. van Tienhoven.
The laboratory provides students with an opportunity to design and execute independently experiments, with limited objectives.

451 Physiology and Biochemistry of Lactation. Spring term. Credit three hours. Lecture, T Th 9:05. Laboratory, Th 2–4:25. G. H. Schmidt.

Anatomy of the mammary gland, the physiological mechanisms of milk secretion, and biochemical synthesis of milk constituents in laboratory and farm animals.

610 Seminar in Animal Reproduction and Endocrinology. Spring term. Noncredit. Open to graduate students with major or minors in animal physiology. T 4:30.

Elementary Animal Physiology (Veterinary 345). Spring term. Credit three hours. Prerequisite: one year of biology or zoology and college courses in chemistry. Lectures and demonstrations arranged especially for students of agriculture but open to others; intended for students who do not plan to continue in physiology or allied fields. M W F 10:10. L. L. Nangeroni.

Introductory Physical Biology (Veterinary Medicine 347). Fall term. Credit three hours. Prerequisite: basic biology, chemistry, and calculus, or permission of the instructor. M W F 10:10. C. L. Comar and R. H. Wasserman.
A basic treatment of the application of physical principles to physiological problems. Coverage includes: mathematical approach to physiological problems; principles of tracers; kinetics; systems analysis and control theory; physiochemical principles; flow of energy in living systems; flow of mass in living systems; contractility.

Introduction to Animal Physiology (Veterinary Medicine 346). Spring term. Credit three hours. Prerequisite: one year of biology and zoology, college courses in chemistry, and basic college mathematics. M W F 11:15. D. N. Tapper and others.
The identity and functions of the organ—systems of mammals, ruminant and nonruminant, with general comparisons to other forms. Particular emphasis is given to circulation, respiration, digestion, excretion, metabolism, and endocrine controls. The lectures, demonstrations, and exercises are intended to serve as a basis for subsequent work in the physiological sciences.

Mammalian Physiology (Biological Sciences 414).

Animal Nutrition

112 Livestock Nutrition. Spring term. Credit four hours. S-U grades optional. Prerequisite: Chemistry 103, 207, or Biological Sciences 131. Recommended: Animal Science 100. Lecture, M W F 10:10. Laboratory, M T W Th or F 2–4:25. S. E. Smith.
Introduction to animal nutrition, covering fundamentals of nutrition, the composition of feeds, feeding standards, and their application to various forms of production in dairy and beef cattle, sheep, swine, and horses.

311 The Principles and Practice of Animal Feeding. Spring term. Credit three hours. Offered primarily for students in the Veterinary College. Non-Animal Science, preveterinary students may complete this course as the basic nutrition prerequisite to the Veterinary College. Animal Science majors should complete courses 112 and 410. Lectures, W F 8. Laboratory, W 2–4:20. D. E. Hogue.
Consideration is given to the basic principles of animal nutrition, nutritive requirements for various body functions; the identification, composition, and nutritive value of feeds; and the formulation of animal rations. The species covered include dairy cattle, beef cattle, sheep, swine, and horses, and there will be some consideration of dogs, cats, and other small animals.

410 Principles of Animal Nutrition, Lectures. Fall term. Credit three hours. Prerequisite: Organic chemistry. Biochemistry is recommended prior to or concurrently. M W F 8. R. G. Warner; H. F. Hintz, M. C. Nesheim.
The principles of nutrition involving a discussion of proteins, fats, carbohydrates, and vitamins and minerals and their importance in animal nutrition.

411 Principles of Animal Nutrition, Laboratory. Fall term. Credit one hour. Enrollment limited to 12 students. Must be concurrently registered in 410. Registration by permission only. Time to be arranged. R. G. Warner; H. F. Hintz, M. C. Nesheim.
Laboratory problems with animals will be designed to introduce the student to techniques of experimentation in nutrition.

415 (Poultry Sci. 415) Poultry Nutrition. Spring term. Credit one hour. Prerequisite: Animal Science 410 or permission of the instructor. F 11:15. M. C. Nesheim.
Intended to provide a discussion of applications of principles of nutrition to feeding poultry. Feed formulations will be stressed with emphasis on linear programming and computer formulation.

511 Laboratory Work in Animal Nutrition. Fall term. Credit three hours. S-U grades optional. Prerequisite: quantitative analysis and 410, or its equivalent, or permission of the instructor. Laboratory, M W F 2–4:25. W. G. Pond.
Each student engages in a series of short research projects with experimental animals, such as rats and sheep. Both classical and modern techniques of animal experimentation are considered. The applications of biochemical methods to the solution of animal nutrition problems are stressed.

512 (Poultry Sci. 511) Special Topics in Nutrition. Fall or spring term. Credit and hours to be arranged. For graduate students only.

Registration by permission of staff members concerned. R. E. Austic; M. C. Nesheim, and M. L. Scott.
For students desiring experience in planning, conducting, and reporting independent research projects in poultry nutrition.

619 Field of Nutrition Seminar. Fall and spring terms. No credit. M 4:30.
Current research in nutrition presented by visitors and faculty.

Advanced Nutrition

A series of nutrition courses are offered jointly by the Department of Human Nutrition and Food, College of Human Ecology; Department of Animal Science, College of Agriculture; Department of Poultry Science, College of Agriculture; and the Graduate School of Nutrition.

Prerequisites include courses in nutrition, physiology, and biochemistry to include intermediary metabolism, or permission of instructor.

Among the topics presented are the biochemical and physiological bases of digestion, absorption, transport and metabolism of nutrients, and species differences where applicable. Historical as well as current concepts of nutrition are discussed.

Proteins and Amino Acids (Human Nutrition and Food 501). Fall term. Credit two hours. M W 10:10. M. A. Morrison.

502 Lipids. Fall term. Credit two hours. T Th 11:15. A. Bensadoun.

503 Nutritional Energetics. Spring term. Credit two hours. M W 10:10. J. T. Reid.

504 Vitamins and Minerals. Spring term. Credit two hours. T Th 11:15. Rice 300. M. L. Scott.

[505 Biochemistry of Forages and Their Utilization. Fall term. Credit three hours. S-U grades optional. Prerequisites: Animal Science 410 and Biochemistry 431, or permission of the instructor. M W F 12:20. P. J. Van Soest. Not offered 1974–75.
The nutritional biochemistry of forage plants, rumen fermentation, and the factors influencing the use of cellulosic materials as food. Chemical composition of plants and factors influencing their nutritive value.]

[513 Forage Analysis. Fall or spring term. Credit two hours. Prerequisite: 505 and permission of the instructor. Enrollment limited to five students each term. Laboratory only, to be arranged. P. J. Van Soest. Not offered 1974–75.
Nutritive evaluation of forages and related materials through various chemical and in vitro procedures. Course will include a term paper summarizing results of independent laboratory study of either materials or methods. The student may develop or provide his own forage materials.]

Departmental Research and Seminars

390 (Poultry Sci. 390) Poultry Problems. Fall or spring term. Credit one, two, or three hours. S-U grades optional. Undergraduates must attach to their preregistration material written permission from the staff member who will supervise the work and assign the grade. R. J. Young.
Investigation of some problem in the field of poultry science by the student under the direction of a member of the staff.

395 Undergraduate Research. Fall and spring terms. Credit one to three hours, depending upon the problem undertaken and extent and quality of work done. Undergraduates must attach to their preregistration material written permission from the staff member who will supervise the work and assign the grade. Open only to juniors and seniors of high scholastic ability with grade averages of 2.7 or above.
Designed to afford opportunities for outstanding undergraduates who plan to go to graduate school to carry out independent studies of suitable research problems under appropriate supervision. Each student will be expected to make a review of the literature, prepare a project outline, conduct the research, and write a summary report.

396 Undergraduate Teaching. Fall or spring term. Credit one or two hours, not to exceed a total of four. Prerequisite: 2.7 cumulative average and an interest in teaching. Written permission of supervising instructor required for registration. Time to be arranged. Staff.
Designed to enable qualified undergraduate students to consolidate knowledge by assisting in a course allied with the student's major training and experience. Each participating student is expected to meet regularly with a discussion or laboratory section; to gain teaching experience; to regularly discuss teaching objectives, techniques, and subject matter content with the professor in charge.

402 Undergraduate Seminar. Spring term. Credit one hour. S-U grades optional. Limited to advanced undergraduates interested in animal science. Hour to be arranged. Staff.
A study of the pertinent literature of special topics in animal science. Students will be required to review current literature and to present oral and written reports.

500 Research. Fall and spring terms. Credit and hours by arrangement. All members of departmental staff.

601 Seminar. Fall and spring terms. Credit one hour. Required of all graduate students taking either a major or a minor subject in animal science. M 11:15. Staff.

609 (Poultry Sci. 609) Seminar in Poultry Biology. Fall and spring terms. S-U grades only. For graduate students. Th 4:15. Members of the Department staff.
A survey of recent literature and research in poultry biology.

Atmospheric Sciences*

101 (201) Basic Principles of Meteorology. Fall term. Credit three hours. Lectures, T Th 11:15. Laboratory, M T W Th or F 1:25–4:25. B. E. Dethier.
Simplified treatment of structure of the atmosphere; heat balance of the earth; general and secondary circulations; air masses, fronts, and cyclones; hurricanes; thunderstorms, tornadoes, and atmospheric condensation. In the laboratory, emphasis is on techniques of analysis of weather systems.

103 (201A) Basic Principles of Meteorology (Laboratory). Fall term. Credit one hour. Prerequisite: Introductory course in Meteorology without a laboratory. M T W Th or F 1:25–4:25. B. E. Dethier.
Techniques of analysis of weather systems and the application of dynamical and empirical methods of prediction of the daily atmospheric circulation.

202 Dynamic Climatology. Spring term. Credit three hours. Prerequisite: 101. M W F 11:15. B. E. Dethier.
The first part of the course is devoted to the description of world climates in terms of the global distribution of radiation, temperature, pressure, and wind; precipitation and air masses. The second part of the course relates climates and climatic anomalies to planetary, regional, and local circulations.

325–326–327–328 Meteorological Communications. Fall and spring terms. Credit one hour. S-U grades optional. Primarily for undergraduate meteorology majors. Time to be arranged. Staff.
The student will become acquainted with facsimile, teletype, and satellite receiving equipment and the data products used in weather forecasting.

[331 Tropical Meteorology. Spring term. Credit three hours. Given in alternate years. Prerequisite: course 101 or 411. M W F 9:05. D. A. Paine. Not offered in 1974–75.
A study of the general circulation of the tropics, easterly waves, hurricanes, monsoons, and local diurnal tropical weather phenomena.]

* Part of the Department of Agronomy.

411–412 Theoretical Meteorology I and II. Fall and spring terms. Credit three hours. Prerequisite: one year each of calculus and physics. Course 411 is prerequisite to course 412, unless special permission is obtained from the instructor. M W F 10:10. W. W. Knapp.
Topics covered in the fall semester: thermodynamics of dry air, water vapor and moist air, atmospheric hydrostatics and stability; spring term: a review of vector operations and fundamentals of fluid mechanics; meteorological coordinate systems; variation of wind and pressure fields in the vertical; winds in the planetary boundary layer; surfaces of discontinuity; mechanisms of pressure change; vorticity and circulation.

[417 Physical Meteorology. Fall term. Credit three hours. Offered in alternate years. Prerequisite: one year each of calculus and physics. M W F 12:20. W. W. Knapp. Not offered in 1974–75.
Primarily, a survey of natural phenomena of the atmosphere with emphasis on their underlying physical principals. Topics include: composition and structure of the atmosphere; atmospheric optics, acoustics and electricity; solar and terrestrial radiation; principals of radar probing of the atmosphere.]

431 Synoptic Meteorology. Fall term. Credit three hours. M W F 9:05. Prerequisite: permission of the instructor. D. A. Paine.
Mathematical tools for studying the scales of atmospheric motion. The flux of heat, moisture, and momentum and the seven "primitive" equations. The origin of waves in the atmosphere and the theory of geostrophic motions.

432 Isentropic Theory and Analysis. Spring term. Credit four hours. Lecture, M W 12:20. Laboratory, T Th 12:20. Prerequisite: 431 and permission of instructor. D. A. Paine.
A four-dimensional look at the atmosphere's structure determined by isentropic trajectories. The energetics of a severe East Coast cyclone will be explored in the laboratory, meeting twice weekly.

438 Atmospheric Pollution. Spring term. Credit three hours. Offered in alternate years. Prerequisite: one year each of calculus and physics. M W F 9:05. D. A. Paine.
Nature of air pollution; its dispersals by atmospheric processes and its effects upon the atmosphere and biosphere.

449 Physics of Clouds, Rain, and Rainmaking. Fall term. Credit three hours. Given in alternate years. Prerequisites: one year each of calculus and physics. M W F 12:20. W. W. Knapp.
Primarily centered on the microphysical processes occurring in natural clouds which lead to the development of precipitation. Subject matter includes: a brief survey of the macrophysical properties of clouds; homogeneous and

heterogeneous condensation processes; growth of cloud particles; natural and artificially simulated precipitation processes.

461–462 Undergraduate Research in Meteorology. Fall and spring terms. Credit one to three hours. Required of honor students in the physical sciences majoring in meteorology. Staff.

471 (571) Numerical Weather Prediction. Fall term. Credit three hours. Offered in alternate years. Prerequisite: 431, 432. M W F 11:15. D. A. Paine.
The theory of barotropic and baroclinic modelling. An equivalent barotropic program will be constructed and run on the computer.

[473 (573) Multiscale Modelling of the Atmosphere. Fall term. Credit three hours. Offered in alternate years. Prerequisite: 431, 432. M W F 11:15. D. A. Paine. Not offered in 1974–75.
An extension of prediction theory, with each student exploring one topic of current interest: the inclusion of latent heat release, cumulus modification of the larger scales, frictional effects, gravity wave adjustment toward geostrophic flow.]

650 (550) Special Topics in Meteorology and Climatology. Fall or spring term. Credit one or more hours. Staff.
Study of meteorological topics more advanced than or different from those in other courses. Subject matter depends on the background and desires of those enrolling.

691 Seminar in Meteorology. Prerequisite: permission of the professor in charge. B. E. Dethier.
Subjects for future times may be such things as weather modification, paleoclimatology, atmospheric pollution. These will be planned and announced in advance.

962 (562) Research in Meteorology. Fall and spring terms. Credit one or more hours. Thesis research. Staff.

Biological Sciences

Students will be provisionally accepted in the Biological Sciences specialization as established by the Division of Biological Sciences during their freshman or sophomore years: application should be made to the Division of Biological Sciences Office. Prior to the senior year the student must have written approval of the Division of Biological Sciences of his admission to the major. Final admission to the specialization will require completion of:

(1) a year of biology (Biological Sciences 101–102 and 103–104 or 105–106; advanced placement may be allowed at the student's choice, on receipt of a score of 5 in the Advanced Placement Test of the College Entrance Examination Board or a score of 4 **and** completion of Biological Sciences 107);
(2) a year of general chemistry (preferably Chemistry 207–208 or 215–216);
(3) a year of college mathematics including at least one semester of calculus (Mathematics 105–106, 111–112).

Whenever possible, the student should include the above three subjects in his freshman schedule and complete organic chemistry and genetics in the sophomore year. A student is not encouraged to undertake a specialization in biological sciences unless his performance in the above courses gives evidence of capacity to do satisfactory work at a more advanced level.

In addition to the introductory courses in chemistry, biological sciences, and mathematics, each specializing student must complete the following:

(1) Chemistry 253–251 (or 251 and 357–358, or 253–300–301, or 357–358–301);
(2) a year of physics (Physics 101–102 or 207–208);
(3) Biological Sciences 281 (Genetics);
(4) Biological Sciences 431 or 432 (Biochemistry);
(5) the breadth requirement outlined below;
(6) one of the concentration areas outlined below; and
(7) a minimum of six hours of college credit in a modern foreign language. Qualification in a foreign language, as defined by the College of Arts and Sciences, meets the Division's language requirement.

Students anticipating a concentration in biochemistry should contact an adviser in biochemistry as soon as possible.

The breadth requirement is designed to ensure that each major student becomes familiar with a minimum number of different aspects of modern biology. In fulfillment of this requirement, each student must pass one of the listed courses in two of the following eight categories:

(1) *Neurobiology and Behavior:* Courses 321, 421, Psychology 201, 323
(2) *Development Biology:* courses 347, 386
(3) *Ecology and Evolution:* courses 261, 301, 361, 476
(4) *Microbiology:* course 290A
(5) *Morphology:* courses 373, 313, 316, 345, plant pathology 309
(6) *Physical Science and Mathematics:* courses Chemistry 389 or 288, Geology 101, Math 213 or 221, Physics 360, Statistics 407, 408 or 510, Computer Science 201, 202, 311
(7) *Physiology:* courses 242, 340, 410, 414 Vet. Med. 346, 347
(8) *Taxon-oriented courses:* 371, 344, 470, 471, 472, 474 Entomology 212

The concentration requirement is designed to help the student achieve depth in some area of biology of his own choosing. It permits maximum flexibility, while ensuring that the selection of advanced courses will form a coherent and meaningful unit. The student should seek the advice of his adviser in selecting the course he will take in fulfillment of both the breadth and concentration requirements. No more than four credit hours of research courses can be used for completion of the requirements in the area of concentration. The possible concentration areas are:

(1) Animal Physiology and Anatomy: Biological Sciences 373 and one course each from list A and list B with the provision that one laboratory course has to be included in the choice from list B (e.g. a student could take Veterinary Medicine 346 without taking 346 laboratory but then would need to take Biological Sciences 414 or Biological Sciences 410 and 411).
List A: Histology, the Biology of Tissues (Biological Sciences 313), four hours; Animal Embryology (Biological Sciences 384), four hours; Vertebrate Anatomy (Veterinary Anatomy 900), three hours; Invertebrate Zoology (Biological Sciences 316), four hours.
List B: General Physiology (Biological Sciences 410), three hours; General Physiology Laboratory (Biological Sciences 411), two hours; Mammalian Physiology (Biological Sciences 414), six hours; Introductory Physiology (Veterinary Medicine 346), three hours; Introductory Physiology Laboratory (Veterinary Medicine), one hour; Fundamentals of Endocrinology (Animal Science 425), four hours.
(2) Neurobiology and Behavior: Biological Sciences 321, and twelve hours, including a second course in neurobiology, to be selected in consultation with the adviser.
(3) Biochemistry: The student must fulfill the organic chemistry requirement by taking Chemistry 301, 302, 357, 358. In addition the student must take Chemistry 389–390, or 287–288 and Biological Sciences 530 or 430.
(4) Botany: Biological Sciences 242 (or 340), 345, 347, and 371.
(5) Ecology and Systematics: At least 13 hours including courses 361 and 476; three or more credit hours from 400 or higher level courses in Ecology, Systematics and Evolution, and a physiology course. At least

four laboratory courses must be included, but students may count two courses taken for breadth requirement as laboratory requirement. Students planning graduate study are strongly urged to take a course in statistics (ILR 210 or 311).

(6) Genetics and Development: Nine hours usually selected from the following courses: 280, 347, 386, 387, 440, 441, 476, 480, 484, 485, 486, 488; Statistics 510, Plant Breeding 505.

(7) Students who, for good reason, wish to undertake a course of studies not covered by these seven concentration areas may petition for permission to do so.

Students interested in teaching biology in secondary schools are urged to consult an adviser in the Department of Education during their freshman year. Courses appropriate to the student's program are described in the *Announcement of the Field of Education.*

The Honors Program offers a student an opportunity to do independent work under the supervision of a member of the faculty. This entails independent laboratory work on a project in addition to writing a thesis. Candidates for this program must have at least a 3.0 cumulative average, although the committee will entertain petitions for special cases. He must also obtain a sponsor in a biology-oriented basic or applied science within the University. An Honors candidate will ordinarily enroll for credit in a research course under the direction of the faculty member acting as his Honors supervisor. No more than four credit hours of research courses can be used for completion of the requirements in the area of concentration. Recommendation to the faculty that a candidate graduate with Honors will be the responsibility of the Honors Program Committee. Students interested should consult their adviser for further details, preferably during the first term of the junior year.

Students interested in the Honors program must register with the office of the Division no later than the first term of the senior year. The final report of the student's work must be in the hands of the Committee not later than the first day of the study period to the week of the final examinations.

Many decisions pertaining to curriculum, to Division-wide requirements, and to depth and breadth areas, are made by the Curriculum Committee of the Division. The Committee has faculty and elected student members, and welcomes advice and suggestions from all interested parties. The Division office will supply information on Committee affairs.

General Courses

101–102 Biological Sciences. Throughout the year. Credit two hours a term. Must be taken concurrently with 103 and 104 (Laboratory). Biological Sciences 101 is prerequisite to 102, unless special permission is obtained from the instructor. 101–102 cannot be taken for credit after 105–106, or 107, or 109–110. Lectures, M W. Time to be announced. Two preliminary examinations will be offered each term at 7:30 p.m. K. Adler.

Designed both for students who intend to specialize in biological sciences and for those specializing in other subjects, such as the social sciences or humanities, who want to obtain a thorough knowledge of biology as part of their general education. Plant and animal materials are considered together rather than in separate units. The fall semester covers scientific methodology, cellular biology, metabolism, tissue and organ function, and reproduction and development. The spring semester covers genetics, evolution, behavior, and ecology. Each topic is considered in the light of modern evolutionary theory.

103–104 (101L–102L) Biological Sciences, Laboratory. Throughout the year. Credit two hours a term. Must be taken concurrently with 101 and 102. One three-hour laboratory each week and a weekly lecture section for discussions, special lectures, etc. Lecture, F. Time to be announced. Laboratory, M T W or Th 1:25–4:25, or T Th 8–11, or F 10:10–1, or M W 7:30–10:20 p.m. R. E. Zollinhofer and assistants.

Laboratory exercises are scheduled to correspond to the lecture schedule. Exercises are both observational and experimental in approach, and cover plant and animal materials. Students obtain experience in designing experiments, learning diverse methodologies, synthesizing information, using statistical analysis, and in writing reports.

105–106 (103–104) Introductory Biology. Throughout the year. Credit four hours a term (or less by arrangement with the instructor). Lectures T 1:25. K. Arms and P. Camp.

Designed for students who intend to specialize in the biological sciences and for nonmajors. Also open to transfer students who may need fewer than six credit hours in introductory biology. Course material is divided into core units which must be completed by all students and optional units of which students can choose to complete a variable number, depending upon the grade they are working for. The course offers an introduction to cellular structure, function and chemistry, plant and animal physiology and anatomy, heredity, evolution, ecology and behavior. In addition, some areas of biology of particular interest for their social and cultural implications are identified and some are studied in detail in particular units of coursework. An autotutorial format is used and students are expected to schedule their hours in the learning center at their convenience. No class-wide examinations will be held. Laboratory work an integral part of the course.

107 (105) Biological Discovery. Fall term. Two lectures and two laboratories weekly. T Th 9:05. Open to freshmen who achieve a grade of 4 or 5 on either the biology advanced placement exam of the College Entrance Examination Board or an advanced placement exam administered during freshman orientation week. Also open to transfer students with one semester of college biology who attain a grade of 4 or 5 on the freshman orientation-week advanced placement exam. Limited to sixty students. Not open to students who have credit for more than one semester of introductory biology or to students who have credit for 101–102, 105–106, or 109–110. Passing 107 comprises fulfillment of introductory biology requirements in terms of (1) electing more advanced biology courses, and (2) fulfilling the biology distribution requirement for nonmajors. Students with advanced placement grades of 5 receive six credits for previous work in biology and are permitted to exempt all introductory courses including 105. If they take and pass 105, they receive an additional four credits. Students with an advanced placement grade of 4 receive three credits for previous work in biology plus four credits for passing 105. J. M. Camhi.

Designed to instruct students in the ways that scientists ask questions about living things, and design and carry out observations or experiments to answer these questions. In the laboratory, students work in small groups on extended research problems which they help design. Instruction is highly individualized and aims at improving each student's ability to ask meaningful questions, organize and quantify his observations, analyze his research data, and relate his results to previously reported biological findings. Specific research techniques will be introduced when need arises.

Lectures, which expand the scope of the laboratory experience, treat the conceptual and technical underpinnings of biological science, illustrating these with examples from diverse animal and plant disciplines. Biological content stresses properties and processes common to a wide range of living organisms, rather than focusing narrowly upon specific topics. It is hoped that this course will be useful to both potential scientists and to others wishing to attain a deeper insight into the nature of biological science.

108 (106) Interactive Computing for Students of Biological Sciences. Spring term. Credit one hour. Lecture every other week, T 1:25. H. C. Howland.

An introduction to computing using the interactive language FOCAL with a discussion of other algebraic computing languages such as BASIC and elementary FORTRAN. Students will be issued tickets for five hours of computing time at the Division of Biological Sciences interactive computing facility. Applications to problems in the biological sciences will be emphasized. Not open to students with prior courses in computing.

109–110 (107–108) Biology for Nonmajors. Throughout the year. Credit three hours a term. Limited to 680 students. This course can be used to fulfill the Distribution requirement in the Colleges of Arts and Sciences, Human Ecology, and Agriculture and Life Sciences, but may *not* be used as an introductory course for the major in biological science. *Note that this course may not always satisfy as a prerequisite to second- and third-level courses in biology.* Attendance in 109 is requisite for registration in 110, except by special consent. May not be taken after 101–102 or 105–106. Lectures, M W F 9:05 or 11:15. Laboratories M T W Th or F 2–4:15. Each student must attend a laboratory on alternate weeks. Two preliminary examinations will be given each term at 7:30 in the evening; the dates are October 8 and November 14, 1974, and February 25 and April 1, 1975. W. T. Keeton and M. L. Kreithen.

Students who do not plan to major in biology have the opportunity of taking this broad introductory course in modern biology without the necessity of the more detailed study normally required. Nevertheless, it is not a course in social biology but addresses itself to biological principles with academic rigor. The content is designed to appeal to anyone who seeks a comprehensive knowledge of biology as part of his or her general education. Laboratory sections enable small groups of students to meet with the course staff, and will be used for problem-solving experiments, demonstrations and discussion.

202 (201–202) Biology and Society. Spring term. Credit two hours. S-U grades only. May not be repeated. Evening lectures, M 8 p.m. Room to be arranged. Discussion periods (one hour) to be arranged. Staff and invited speakers.

A series of public lectures dealing with a variety of topics concerning man as an individual, man as a member of society, and man as a member of the community of life on earth. The lectures are open to students and non-student members of the Cornell community as well as to other Ithaca-area residents.

Students enrolling for credit are requested to attend and participate in one of the weekly discussion groups. The purpose of the discussion period is to permit students to explore lecture material or related topics in depth. Because the number of students who can be accommodated in Biology 202 is dependent upon an unpredictable and variable number of volunteer faculty members from the many colleges and schools on the Cornell campus, preregistration in this course is not permitted. Preference given to upperclassmen. No preregistration.

203 Special Topics in Social Biology. Fall term. Credit three hours. S-U grades optional. Hours to be arranged. Permission of the instructor is required.
Normally, credit for course 203 will count for neither breadth nor concentration requirement in the Biological Sciences curriculum even if the section is under the direction of a biologist, although this restriction may be waived in isolated cases. This course may not be offered every fall; information can be obtained by calling the Division of Biological Sciences (6-5233), or the Science, Technology, and Society Program (6-3964).

204 Special Topics in Social Biology. Spring term. Credit three hours. S-U grades optional. Hours to be arranged. Permission of the instructor is required. In other respects this course is identical to course 203.

301 Laboratory Methods in Biology. Fall or spring term. Credit three hours. Limited to juniors, seniors, and graduate students; 20 students per section. Prerequisite: 101–102 or equivalent. Scheduled period, T or F 10:10–12:05, consists of lecture and demonstration of work for the following week. Additional periods covered by leaving laboratory open at all times. The equivalent of at least one laboratory period per week required and sometimes several depending on the nature of the work. No formal examinations. Grade is based on required work, turned in at the end of the semester. L. D. Uhler.
For students who intend to teach or follow some phase of biology as a profession. Subjects covered: collection, preservation, and storage of materials; the preparation of bird and mammal study skins; injection of circulatory systems with latex; clearing and staining of small vertebrates; and the preparation and staining of squashes, smears, whole mounts, and sections.

401 Teaching Biology. Spring term. Credit four hours. S-U grades optional. Enrollment limited. Prerequisite: permission to register. Hours to be arranged. R. E. Zollinhofer.
Discussions of recent developments in the teaching of biology, and participation in teaching elementary biology at the college level.

403 Laboratory Design. Fall term. Credit 2–4 hours. Enrollment limited. Prerequisite: permission to register. Hours to be arranged.
Designed to enable qualified students to obtain laboratory teaching experience by actual involvement in the design and teaching of biology laboratories. To determine the prerequisites for enrollment, students wishing to take this course should contact the professor in charge of the laboratory.

405 Optics in Biology. Fall term. Credit two hours. Enrollment limited to twenty. Prerequisite: Chemistry 104 or 208, Mathematics 108 or 111, and Physics 102 or 208, or consent of the instructor. M 1:25–3:20. R. K. Clayton.
Lectures, problems, demonstrations, and laboratory experience in applications of optics to biology. Topics will include geometrical optics as applied to illumination systems, methods for studying biological effects of light, and analytical uses of optical absorption and fluorescence.

503 Electron Microscopy for Biologists. Fall term. Credit three hours. S-U grades optional. Open to graduate students, with preference given to students who have thesis problems requiring electron microscopy. Permission of the instructor required. Preregistration recommended. Enrollment limited to eight. Lecture, T 11:15. Laboratory, T Th 1:25–4:25 or W F 8–11. M. V. Parthasarathy.
Principles of electron microscopy, histological techniques for electron microscopy such as ultrathin sectioning, negative staining and metal shadowing, and interpretation of results. A brief introduction to scanning electron microscope is also included.

504 Advanced Electron Microscopy for Biologists. Spring term. Credit three hours. S-U grades optional. Prerequisite: 503 and consent of instructor. Enrollment limited to eight. Lecture, T 11:15. Laboratory, T Th 1:25–4:25 or W F 8–11. M. V. Parthasarathy.
Designed primarily for graduate students who have a major interest in ultrastructure. Selected topics in cell ultrastructure and interpretation, and introduction to special techniques such as freeze-etching, enzyme digestion techniques, visualization of DNA strands, and autoradiography are included. The student will also be required to do a project involving all or some of the specialized techniques.

Animal Physiology and Anatomy

Introductory Physical Biology (Veterinary Medicine 347). Fall term. Credit three hours. Prerequisite: basic biology, chemistry, and calculus, or permission of the instructor. M W F 10:10. C. L. Comar and R. H. Wasserman.
A basic treatment of the application of physical principles to physiological problems. Coverage includes: mathematical approach to physiological problems; principles of tracers; kinetics; systems analysis and control theory; physiochemical principles; flow of energy in living systems; flow of mass in living systems; contractility.

Introduction to Animal Physiology (Veterinary Medicine 346). Spring term. Credit three hours. Prerequisite: one year of biology and zoology, college courses in chemistry, and basic college mathematics. M W F 11:15. D. N. Tapper and others.
The identity and functions of the organ—systems

of mammals, ruminant and nonruminant, with general comparisons to other forms. Particular emphasis is given to circulation, respiration, digestion, excretion, metabolism, and endocrine controls. The lectures, demonstrations, and exercises are intended to serve as a basis for subsequent work in the physiological sciences.

Introductory Parasitology and Symbiology (Veterinary Medicine [330]). Spring term. Credit three hours. Lectures T Th 11:15. Laboratory T 2:00–4:25. Prerequisite: one year of biology. J. H. Whitlock and J. R. Georgi.
A study of unrelated species living together in intimate physiological association. Parasitoses which result in disease in the host are presented as important and special cases of the symbiotic spectrum. Emphasis is placed on an integrative study of the causation of disease in human beings and cultivated and natural populations of plants and animals. The biological functions of disease and the impact of human activities on the disease structure of populations is examined. Laboratory exercises will involve a broad range of symbiotes and pathogens from viruses to nemas and arthropods. (W. F. Mai, J. P. Kramer and J. H. Gillespie will collaborate in certain aspects of the course.)

313 Histology: The Biology of the Tissues. Fall term. Credit four hours. Prerequisite: a two-semester introductory biology sequence; a background in vertebrate anatomy and organic chemistry or biochemistry desirable. Lectures, T Th 11:15. Laboratory, T Th 2–4:25. W. A. Wimsatt.
Provides the student with a basis for understanding the microscopic, fine structural and functional organization of vertebrates, and the methods of analytic morphology at the cell and tissue levels. The dynamic interrelations of structure, composition, and function in cells and tissues are stressed.

316 Invertebrate Zoology. Either term. Credit four hours. Prerequisite: at least one year of biological science or permission of instructor. Two lectures and two laboratories per week. Lectures, W F 11:15. Laboratory, W F 2–4:25. J. M. Anderson and assistant.
Lectures on selected topics in the development, structure, function, and interrelations of invertebrate animals, with particular attention to phylogenetic aspects. Intensive laboratory work on representative invertebrates, utilizing living or fresh specimens wherever possible. Each student will be expected to do a significant amount of independent work and a term paper may be required.

410 General Animal Physiology: A Quantitative Approach, Lectures. Spring term. Credit three hours. S-U grades optional. Prerequisite: one year of biology and physics; courses in chemistry, organic chemistry, and biochemistry desirable. Lectures, M W F 10:10. H. C. Howland.
The principles of animal physiology are developed through consideration of the functioning of cells, tissues, and organs. Specific topics discussed include respiration, metabolism, circulation, excretion, body mechanics, muscle contraction, nerve action, sensory reception, and central nervous system function. A quantitative, systems-theoretical approach is emphasized.

411 (410A) General Animal Physiology Laboratory. Spring term. Credit two hours. Prerequisite: 410 or equivalent must be taken concurrently. Lecture, W 2. Laboratory, M T Th or F 1:25–4:25. H. C. Howland.
Students are introduced to basic techniques utilized in the study of the physiology of animal tissues. Experiments cover topics dealing with respiration, properties of muscle, circulation, activity of nerves, and osmotic phenomena.

412 Special Histology: The Biology of the Organs. Spring term. Credit four hours. Offered in alternate years. Enrollment limited to eighteen students. Prerequisite: 313 or consent of instructor. Lectures, W F 9:05. Laboratory, W F 2–4:25. W. A. Wimsatt.
A continuation of course 313. The microscopic and ultrastructural organization of the principal vertebrate organ systems are studied in relation to their development, functional interaction, and special physiological roles. Courses 313 and 412 together present the fundamental aspects of the microscopic and submicroscopic organization of the vertebrate. The organization of the course involves student participation in lecture-seminars, and the prosecution of independent project work supplementary to the regular work of the laboratory. The latter enables students to gain practical experience with histological and histochemical preparative techniques.

414 Mammalian Physiology. Spring term. Credit six hours. Students desiring registration should file written application form at 438 Morrison. Prerequisite: a year of biological sciences. Courses in biochemistry, histology, and gross anatomy desirable. Lectures, M W F 8. Discussion, S 10:10. Laboratory, M or W 1:25. W. J. Visek; A. Bensadoun, E. L. Gasteiger, Jr., and W. Hansel.
A general course including circulation, respiration, digestion, metabolism, renal function, endocrinology, and the nervous system.

418 Seminar in Anatomy and Physiology. Either term. Credit one hour. Time to be arranged. Limited to Juniors and Seniors. Organizational meeting first Tuesday of each semester. Staff.

419 Research in Animal Physiology and Anatomy. Fall or spring term. Credit and hours to be arranged. Undergraduates must attach to

their preregistration material, written permission from the staff member who will supervise the work and assign the grades. Staff.
Practice in planning, conducting, and reporting independent laboratory and/or library research programs.

512 Comparative Physiology. Spring term. Credit two hours. Students are encouraged to enroll in 512A concurrently. T Th 9:05. W. N. McFarland and F. H. Pough.
A comparison of the principal physiological functions of vertebrates and invertebrates, with emphasis on adaption to different environments. Offered in alternate years. Not offered in 1975–76.

513 (512A) Comparative Physiology Laboratory. Spring term. Credit two hours. Limited to twelve students. Prerequisite: concurrent enrollment in 512 and consent of instructor. T Th 1:25–4:25. Includes small group projects. W. N. McFarland and F. H. Pough.
Introduction to comparative physiological techniques and their application to original research projects. Not offered in 1975–76.

Animal Embryology (Biological Sciences 386).

Comparative Physiology of Reproduction of Vertebrates (Poultry Science 425).

Developmental Anatomy and Histology (Veterinary Anatomy 507).

Elements of Physical Biology (Veterinary Medicine 920).

Fundamentals of Endocrinology (Animal Science 427).

General Photobiology (Biological Sciences 547).

Neuroanatomy (Veterinary Anatomy 505).

Optics in Biology (Biological Sciences 405).

Insect Morphology (Entomology 322).

Sensory Function (Biological Sciences 427).

Vertebrate Morphology (Veterinary Medicine 700).

Vision (Biological Sciences 425).

The Vertebrates (Biological Sciences 373).

Neurobiology and Behavior

321 Neurobiology and Behavior. Fall term. Credit three hours. Limited to juniors, seniors, and graduate students. Prerequisite: 101–102. Lectures M W F 8. T. Eisner, M. Eldefrawi, and staff.
Evolution of behavior, cueing of behavior; social and nonsocial behavior, neuroanatomy, neurophysiology, neurochemistry, neural networks, memory.

322 (323A) Physiological Psychology Laboratory. Spring term. Credit three hours. May be taken on an S-U basis with consent of the instructor. Prerequisite: 321, Psychology 201, concurrent registration in 323, and consent of instructor. Discussion, M 7:30–9 p.m. Laboratory, T 1:25–4:24. B. P. Halpern.
Experiments will be done on physiological aspects of conditioning in vertebrates and invertebrates, memory, interactions between hormones and behavior, and effects of brain lesions on perceptual and alimentary behavior. A final original experiment will be planned and carried out.

323 Physiological Psychology. Spring term. Credit three hours. Prerequisite: Biological Sciences 101–102 or equivalent and introductory chemistry; Psychology 201 or a 300-level course in psychology. Lectures T Th 9:05. B. Halpern.
Selective examination of neural, endocrine, and biochemical functions related to emotion, memory, learning, perception, hunger, thirst and sleep.

[324 Animal Social Behavior. Spring term. Credit four hours. Prerequisite: 101–102 or 105–106. Not open to students who have already taken 523. Not offered 1974–75.]

325 Cellular Organization of the Nervous System. Spring term. Credit three hours. Prerequisites: 101–102 and 321; the latter may be waived by permission of the instructor. Lectures, T Th 11:15. M. M. Salpeter.
Special emphasis is on development, functional relationships, and ultrastructure.

326 Elementary Neurophysiology. Fall term. Credit three hours. Prerequisite: 325 or permission of the instructor. Lectures, T Th 9:05. Discussion T 7 p.m. T. R. Podleski.
Lectures will examine the biophysical and biochemical properties of the excitable membranes of nerve cells and muscle. Topics to be studied include the origin of bioelectric potentials, excitability, synaptic transmission, neural circuits, the specificity of neural membranes, and possible mechanisms for plasticity.

328 Behavioral Maturation. Fall term. Credit three hours. Prerequisite: 323. Lectures M F 12:20. E. H. Lenneberg.
Emergence of behavior will be studied in the light of developmental biology, including behavior genetics, neuroembryology and morphogenesis, physical maturation of the brain, transformation and allometry as well as retarding influences from the environment.

420 Principles of Neurobiology Laboratory (Also Psychology 420). Spring term. Credit four hours. Prerequisites: Biological Sciences 326 or 427 or 428 (may be taken concurrently), and permission of instructors. M T W or Th 1:25–4:25. Enrollment limited to thirty-six students. B. Halpern, T. Podleski, D. Tapper, and staff.
Laboratory practice with neurobiological preparations and experiments, designed to teach the students the techniques, experimental designs, and research strategies used to study biophysical and biochemical properties of excitable membranes, sensory receptors, the central nervous system transformation of afferent activity, the characteristic composition and metabolism of neural tissue. The course will be divided into two segments: an initial segment (approximately six weeks) in which fundamental techniques will be learned and used in experiments by all students; a second segment (approximately eight weeks) in which students will learn and use more specialized techniques for experiments in either elementary neurophysiology of excitable membranes, or sensory function, or neurochemistry.

421 Comparative Vertebrate Ethology. Fall term. Credit three hours. S-U grades optional. Prerequisite: 101–102 or 103–104, and 321, and permission of the instructor. Lectures, T Th 9:05. Laboratory, to be arranged. W. C. Dilger.
A survey of the methods and principles of vertebrate ethology for students specializing in this field or for those in other branches of zoology wishing to broaden their knowledge of animal behavior. Emphasis is placed on the causation, function, biological significance, and evolution of species-typical behavior. The laboratories are designed to give first-hand knowledge of the material covered in lectures.

423 Animal Communication. Fall term. Credit four hours. Enrollment limited to thirty-two students. Prerequisites: Biological Sciences 321 and Physics 101–102 or 207–208. Lectures, T Th 10:10. Laboratory, T or Th 1:25–4:25 and other meetings to be arranged. R. R. Capranica and R. Hoy.
The functional aspects of biological signals, their physical properties, and the physiological mechanisms underlying their generation and reception. Lectures will examine in detail selected biological communication problems from each of the known sensory modalities. Discussion will cover signal analysis, transmission properties, and the limitation of each type of communication. Laboratories will include behavioral observations under both field and captive conditions, and individual experience with the techniques of signal recording and analysis.

424 Brain and Behavior. Fall term. Credit three hours. Prerequisite: familiarity with theories of perception, memory, and physiological psychology, or permission of the instructor. Th 2:30–4:30. E. H. Lenneberg.
A theoretical introduction to human neurology. This survey of clinical symptoms and their etiology is designed to enable students to make use of disease for research purposes.

[425 Vision. Fall term. Credit two hours. Prerequisite: Chemistry 104 or 108, Mathematics 108 or 111, Physics 102 and 208, or consent of the instructor; concurrent or previous enrollment in Biological Sciences 405 recommended. Lectures T Th 10:10. R. K. Clayton. Not offered in 1974–75.
A study of the mechanism of seeing and embracing biological, physical, and chemical approaches to the subject.]

426 Neuropharmacology. Spring term. Credit three hours. Prerequisite: 431 and 321, or consent of instructor. Lectures M W F 8. M. E. Eldefrawi.
Deals with drugs that affect the nervous system, both central and peripheral. Emphasis will be on mechanisms of drug action whereby basic biochemical processes and neurophysiological and behavioral phenomena are bridged. Among the topics discussed are stimulants, anesthetics, hallucinogens, and neurotoxins. Topics covered will also include drug addiction, psychopharmacology, endocrine pharmacology, and the biochemical basis of the therapeutic uses of drugs in diseases of the nervous system.

427 Sensory Function. Fall term. Credit three hours. Prerequisite: 321 or the equivalent. Lectures, M W F 11:15. Discussion period to be arranged. B. P. Halpern and D. N. Tapper.
Sensory receptors and the central nervous system transformation of afferent activity will be considered in relation to human and animal psychophysical data and to the adaptive significance of behavior. The receptors will be examined in terms of anatomy, biochemistry, biophysics of transduction, and the central nervous system control of peripheral input. Information and signal detection theories will be applied.

[428 Neurochemistry. Spring term. Credit three hours. Prerequisite: 431 and 326, 427 or 524, or their equivalent. Enrollment approximately 50–100 students. Lecture-discussion T Th 11:15–12:45.
Special features of the composition and metabolism of neural tissue will be discussed. The identification of synaptic transmitters in the nervous system, including their specific localization, biosynthesis and metabolism, release, inactivation, and action on postsynaptic receptors will be considered in detail. Chemical aspects of vision and of neuronal development and maturation will also be studied. Not offered 1974–75.]

429 Research in Neurobiology and Behavior. Fall or spring term. Credit and hours to be arranged. S-U grades optional. Undergraduates must attach to their preregistration material written permission from the staff member who will supervise the work and assign the grade. Staff.
Practice in planning, conducting, and reporting independent research programs.

523 Evolution of Social Systems. Spring term. Credit four hours. S-U grades optional. Will alternate with an undergraduate course on the same subject beginning spring 1975. Prerequisites: Course work in animal behavior, ecology, and evolutionary theory. Lectures T Th 9:05. Discussion hours to be arranged. S. T. Emlen.
A combined lecture and discussion course dealing with the interrelationships of animal behavior and ecology, emphasizing adaptive strategies of social behavior. Topics include: Behavioral adaptations to the environment; ecological significance of different spatial organizations (territoriality, coloniality, nomadism); evolution of cooperative and communal social behavior; ecological constraints on monogamous, polygamous, and promiscuous mating systems; optimization of foraging strategies; predator-prey interactions; role of social behavior in population limitation.

524 Behavioral Neurophysiology. Spring term. Prerequisite: 321 or equivalent. One two-hour small discussion group weekly, time to be arranged. One lecture weekly, T Th or S 9:05. Enrollment limited to 25 students. J. M. Camhi.
Small group discussions of selected readings on a variety of related subjects; possible topics include (1) neuronal control of orientation behavior, (2) neuronal control of rhythmic behavior, (3) development of behavior and the nervous system, (4) sensory integration and behavior, (5) synaptic integration and behavior. Lectures will be presented as needed to aid in understanding material covered in groups. Opportunity provided for some students to lecture to the class.

525 (524A) Behavioral Neurophysiological Laboratory. Spring term. Credit two hours. Enrollment limited to 15 students. Course 524 must be taken concurrently. Time to be announced. J. M. Camhi.
Experiments in neurophysiology, often related to specific behavior patterns.

526 (525) Functional Organization of the Mammalian Nervous System (Lecture). Fall term. Credit three hours. Offered in alternate years. Offered next, fall 1974. Prerequisite: two years of biological science. Courses in biochemistry, physics, and neural anatomy are desirable. Lectures, M W F 10:10. E. L. Gasteiger.
Cellular, sensory, central integrative, and motor aspects of the nervous system will be considered with an emphasis on the electrophysiological approach.

527 Functional Organization of the Mammalian Nervous System, Laboratory. Fall term. Credit three hours. Concurrent registration in 526 requisite. Laboratory, W 1:25. E. L. Gasteiger.
Studies will include electrical activity of cells, reflexes, decerebrate rigidity, acoustic microphonic response, subcortical stimulation, and evoked and spontaneous cortical activity.

528 (526) Bioelectric Systems. Spring term. Credit three hours; four hours with laboratory. Prerequisite: 423 or 427 or 524, or Physics 360, or Electrical Engineering IEE 312. Permission of instructor required for laboratory. Lectures, M W 9:05. Discussion and demonstrations, Th 2. R. R. Capranica and M. Kim.
The application of systems techniques to biological problems. Electrical activity of nerve cells; generation and propagation of nerve impulse; voltage clamp technique. Hodgkin-Huxley model; electrical excitability and transfer function of neuromuscular systems; synaptic transmission; models of nerve cells and control system analysis of oscillatory activity. Nerve nets: evoked activity; spontaneous activity; simulation and computer analysis. Functional neuroanatomy of brain; transfer characteristics of sensory receptors; sensory encoding and processing in the peripheral and central nervous systems; neural mechanisms for vision and hearing.
Projects for the optional laboratory sessions to be arranged. Possible topics include: measurement of EKG and EEG, digital computer stimulation and systems analysis of electrophysiological data; design of electronic instrumentation for biological and medical experiments.

620 Seminar in Neurobiology and Behavior. Fall or spring term. Credit one hour. S-U grades optional. Primarily for undergraduates. Time to be arranged. Organizational meeting, first Monday of semester, Caldwell 100, 8 p.m. Staff.

[622 Seminar in Ecological Animal Behavior. Spring term. Credit two hours. Open to qualified graduate and undergraduate students who have taken courses in animal behavior and ecology, and who have secured permission of the instructor. Time to be arranged. Enrollment limited to twelve students. Not offered 1974–75.]

629 Advanced Topics in Neurobiology and Behavior. Fall or spring terms. A seminar course for graduate students and selected undergraduates. Topics, credit, and hours to be arranged. Staff and students.
Designed to provide several study groups each semester on specialized topics. A group may meet for whatever period is judged adequate to

enable coverage of the selected topics. Ordinarily, topics will be selected and circulated during the preceding semester. Suggestions for topics should be submitted by faculty or students to the chairman of the Section of Neurobiology and Behavior.

Optics in Biology (Biological Sciences 405).

Biochemistry

130 Orientation Lectures in Biochemistry. Spring term. Noncredit. For freshman and sophomore students. Lectures and demonstrations covering interesting areas of biochemistry. First three Saturdays of term 9:05–10:30. J. L. Gaylor and staff.

131 Introductory General Biochemistry. Fall term. Credit six hours. A terminal course primarily for nonscience undergraduates. Lectures, M T W Th 11:15. Recitation, Th 2–4:25. A. L. Neal. Lectures, demonstrations, and recitations dealing with selected fundamental principles of general, organic and biochemistry with emphasis on biochemistry.

231 Introductory Biochemistry. Fall term. Credit three hours. Prerequisite: Chemistry 104 or 208, or the equivalent. May not be taken for credit by students who have completed a more advanced course in this section. Lectures, T Th F 12:20. A. L. Neal.
A brief survey of organic chemistry as related to biological compounds and a discussion of selected biochemical topics and reactions associated with the metabolism of animals, plants, and microorganisms and a discussion of selected biochemical topics. Especially designed as a general course for four-year students in agriculture.

430 Basic Biochemical Methods. Either term. Credit four hours a term or four hours for two terms or two hours a term. Prerequisites: 431 and permission of instructor. Laboratory, lecture-discussion, M W 12:20–4:25 or T 9:05–4:25 or Th 9:05–4:25 (four credits); T 12:20–4:25 or Th 12:20–4:25 (two credits). J. M. Fessenden-Raden, L. D. Wright, and R. R. Alexander. Students must preregister with instructor by April 4 for fall term and November 1 for spring term.
A modular course designed to meet the practical biochemical needs of students concentrating in other disciplines. Choice of modules emphasizing clinical biochemistry, nutritional biochemistry, plant biochemistry and analytical biochemistry. Students enrolled for four credits will go into more depth and will complete more modules than students enrolled for two credits.

431–432 Principles of Biochemistry. *NOTE:* During 1974–75, Biological Sciences 431–432 will be given in two formats: lectures (431) and individualized instruction (432). *Lectures will be given fall term only. Individualized instruction will be offered to a maximum of one hundred fifty students each term.* All students intending to take 431–432 in the fall should attend the first class meeting, M 10:10, September 2.

431 Principles of Biochemistry (Lectures). Fall term. Credit four hours. Prerequisite: Chemistry 253 or the equivalent. M W F S 10:10. R. E. McCarty and staff.
A basic course dealing with the chemistry of biological substances and their transformations in living organisms.

432 Principles of Biochemistry (Individualized Instruction). Either term. Credit four hours. Prerequisite: Chemistry (353–355) or the equivalent. Students must have one of the following free: M W F 8 or M W F 10:10. First meeting in fall, M 10:10 September 2. R. Wu, J. M. Griffiths, and staff. First meeting in spring, M 10:10, January 27. J. M. Calvo, J. M. Griffiths, and staff.
The focal point for this course is a study center where students find materials, get help, participate in discussions, and take exams. The study center will be open mornings, afternoons, and evenings. Students are required to master a minimum body of core material. The pace at which this material is assimilated will, to a large extent, be self-determined. Students who wish to go beyond core material will have available a wide range of electives including discussions of research papers, independent study of a variety of problems, *Scientific American* articles, and original research literature. There are no formal lectures. Grades above C will be determined primarily by the amount of elective work satisfactorily completed. Each group of twenty-five students will have contact with an instructor, a teaching assistant, and an undergraduate assistant.

435–436 (435–436) Undergraduate Biochemistry Seminars. Either term. Credit one hour each term. Juniors and seniors only. Enrollment limited. Prerequisite: Biological Sciences (431) or consent of instructor. First meeting of each term is on the first Tuesday at 4 p.m. Fall term, D. B. Zilversmit; spring term, staff.
A group of selected papers from the literature will be critically evaluated during six or seven two-hour meetings. A term paper will probably be required. Fall term, Lipids and biomembranes; spring term, to be announced.

437 Cell Biology. Spring term. Credit three hours. Intended primarily for Juniors and Seniors. Some knowledge of Biochemistry assumed. Lectures M W F 12:20–1:25. A. J. Gibson and R. E. MacDonald.
An introduction to the properties of cells singly and in communities. The concepts of cell growth, structure and differentiation in prokaryotic and eukaryotic communities will be examined and

compared with emphasis on cellular dynamics and interactions.

438 Laboratory in Cell Biology. Spring term. Credit three hours. Prerequisite coregistration in 437 and permission of instructor. Enrollment limited. M W 1:25–4:25; or F 9:05–4:25. Discussion arranged. A. J. Gibson and R. E. MacDonald.
An introduction to techniques of handling cells in the laboratory. Cell material will vary to give the students the widest practical experience in the problems inherent in different systems.

439 Research in Biochemistry. Either term. Credit hours to be arranged. For undergraduate students concentrating in biochemistry. Prerequisite: adequate ability and training for the work proposed. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. J. L. Gaylor and staff.
Special work in any branch of biochemistry on problems under investigation by the staff of the section.

530 Intermediate Biochemical Methods. Spring term. Credit four hours. Prerequisites: Chemistry 358 and 431 or concurrent registration in 532. Laboratory T or Th 9:05–4:25. Discussion period to be arranged. D. B. Wilson and staff.
Intended for undergraduates majoring in biochemistry and for graduate students with a minor in biochemistry. Preregistration must be made with an instructor by November 1.
Selected experiments on carbohydrates, proteins, amino acids, and metabolism (cellular particulates, kinetics, general enzymology) will be given to illustrate basic biochemical principles. The course will emphasize the quantitative aspects rather than qualitative identifications.

531–532 Intermediate Biochemistry (Lectures). 531 fall term only; 532 spring term only. Credit four hours a term. Prerequisites: Chemistry 357–358 and 431 or consent of instructor. Calculus and Physical Chemistry highly desirable. Lectures M T W Th F 9:05. Examinations, optional background or advanced lectures, and discussion sections may be scheduled on Th evenings. Fall term, J. K. Moffat; spring term. P. C. Hinkle.
The major areas of biochemistry and molecular biology will be covered in detail. Fall term: proteins and the nature of enzymatic catalysis; biosynthesis of informational macromolecules. Spring term: carbohydrate, nitrogen, and lipid metabolism; bioenergetics.

[534 Biochemistry of the Vitamins and Coenzymes. Spring term. Credit two hours. Offered in alternate years. Prerequisites: Chemistry (353) and Biological Sciences (431) or their equivalents. Lecture, T Th 10:10. Not offered in 1974–75. D. B. McCormick.
The chemical, biochemical, and nutritional aspects of the vitamins and coenzymes.]

535 Advanced Biochemical Methods I. Fall term. Credit six hours. Laboratory T Th 10:10–4:35. Discussions to be arranged. Limited to graduate students majoring in biochemistry. E. B. Keller and staff.
Each student will carry out a research project during which he will learn the basic techniques of biochemical research.

536 Advanced Biochemical Methods II. Spring term. Credit six hours. Limited to graduate students majoring in biochemistry. S-U grades only. Staff.
Students will do research in the laboratories of three different professors chosen by the student.

537 Basic and Applied Science Coordination Course in Biochemistry. Fall term. Credit one hour. Prerequisite: Biological Sciences (431) or equivalent. M 7:30–9 p.m. E. Racker.
Consists of a series of lectures and seminars of problems of basic and applied biochemistry and its coordination. Enrollment is limited to graduate students in the biological sciences.

631–632 Research Seminar in Biochemistry. Either term. Credit one hour each term. S-U grades only. M 7:30–9 p.m. E. Racker.
Required of all graduate students (first-year students excepted) majoring in biochemistry. The course may be repeated for credit.

633–638 Advanced Biochemistry. Throughout the year. Lectures and seminars on specialized topics, three topics per term. Credit one hour per topic. Prerequisite: 532 or consent of instructor. May be repeated for credit.
The following fields will be covered. Enzyme Structure and Mechanism of Action (fall, 1974); Aspects of Protein and Nucleic Acid Synthesis (spring, 1975); Structure, Function, and Synthesis of Biological Membranes (fall, 1975); Structure and Function in Metabolic Systems (spring, 1976).

633 Topic to be Announced. Fall term 1974. First 4½ weeks of term. T Th 9:05. Staff.

634 Nucleic Acids. Spring term 1975. First 4½ weeks of term. T Th 9:05. L. A. Heppel.

635 Analytical Ultracentrifugation. Fall term 1974. Middle 4½ weeks of term. T Th 9:05. R. H. Crepeau.

636 Regulation of Intermediary Metabolism. Spring term 1975. Middle 4½ weeks of term. T Th 9:05. W. J. Arion.

637 Problems in Sequencing Nucleic Acids. Fall term 1974. Last 4½ weeks of term. T Th 9:05. R. Wu.

638 Regulatory Mechanisms in Protein Synthesis. Spring term 1975. Last 4½ weeks of term. T Th 9:05. D. B. Wilson.

639 Biochemistry Seminar. Fall and spring terms. Noncredit. F 4:25. Staff.
Includes lectures on current research in biochemistry presented by distinguished visitors and staff.

See also, for optional credit in Biochemistry:

Biological Science 548 Plant Physiology: Aspects of Metabolism

Veterinary Medicine 512 Vertebrate Biochemistry

Botany

145 Plant Biology. Fall term. Credit three hours. Limited to 96 students. Prerequisite: Biological Sciences 101–102 or equivalent. Lectures, T Th 9:05. Laboratory, M T W Th or F 1:25–4:25 or W 7:30–10:30 p.m. Maximum 16 students in each laboratory. H. P. Banks and assistants.
Introductory botany for those who plan to specialize in some aspect of, or to make some utilization of the plant sciences. Emphasizes structure, function, reproduction and classification of angiosperms, and the history of life on earth. Emphasis in laboratory is placed on the development of skills in handling plant materials, including identification and several field trips.

[242 Plant Physiology. Spring term. Credit five hours. Primarily for undergraduates in the agricultural sciences. Prerequisite: 101–102 and introductory chemistry. Lectures, T Th S 10:10. Conference, M T W or Th 12:20–1:10. Laboratory, M T W or Th 1:25–4:25. Conference and laboratory must be on same day. The laboratory is the same as for course 340. P. J. Davies and R. M. Spanswick. Not offered spring 1975.
Plant physiology as applied to plants growing in communities. Examples will deal with crop plants or higher plants where possible, though not exclusively. Topics will include cell structure and function; soil-plant-water relations; water uptake, transport and transpiration; irrigation of crops; sugar transport; mineral nutrition of crops; respiration and photosynthesis; light relations in crops; growth and development-hormones, flowering, fruiting, dormancy, and abscission; chemical control of plant growth.]

340 Plant Physiology. Spring term. Credit three hours. Prerequisite: 101–102 and organic chemistry. Must be accompanied by 342 except by permission of the instructor. Lectures, T Th S 10:10. A. T. Jagendorf.
The behavior, growth, transport processes, and environmental response of plants. Topics will include membrane properties, solute and water transport, function of osmotic forces; mineral and organic nutrition; stress resistance; growth and hormonal action; metabolism including photosynthesis and respiration; responses to gravity, light, photoperiod, and temperature.

342 Plant Physiology Laboratory. Spring term. Credit two hours. Must be accompanied by 340. Conference and laboratory must be on the same day. Conference M T W or Th 12:20–1:10. Laboratory, M T W or Th 1:25–4:25. A. T. Jagendorf and R. M. Spanswick.

344 Phycology. Spring term. Credit four hours. Lectures, M W F 10:10. Laboratory, M or F 2–4:25. J. M. Kingsbury.
An introduction to freshwater and marine algae including consideration of their ecology as members of the plankton and benthos and their importance to man. The laboratory, utilizing field material and cultures from an extensive living collection, is designed to illustrate lecture topics, provide familiarity with algae in the field, and introduce the student to techniques used in isolating, culturing, and studying algae in the laboratory.

345 Plant Anatomy. Fall term. Credit four hours. Prerequisite: 101–102 and preregistration with instructor in charge. Lectures, T Th 8. Laboratory, T Th 10:10–12:35 or M W 2–4:25. D. J. Paolillo.
A descriptive course with equal emphasis on development and mature structure. Lecture, laboratory, and reading are integrated in a study guide. The laboratory offers the opportunity to develop the practical skills required to make anatomical diagnoses and to write anatomical descriptions.

347 Cytology. Fall term. Credit four hours. Prerequisite: 101–102 or the equivalent; 281 recommended. Lectures, M W 9:05. Laboratory, M W or T Th 10:10–12:35. C. H. Uhl.
A study primarily of the structure of cells and their components and the relation of these to function and to heredity. Special attention is given to chromosomes. Both plant and animal materials are used.

350 (349) Plants and Man. Spring term. Credit three hours. S-U grades optional. Lectures and discussions, M W F 8. D. M. Bates.
A consideration of the role of plants in the human environment and in the evolution of civilizations. Intended for students in all colleges. Emphasis is on ethnobotanical considerations and on historical to present day utilization of plants in nutrition, housing, clothing, medicine, religion, and the arts.

[440 Cytogenetics. Spring term. Credit three hours. Offered in alternate years. Prerequisite: courses 347 and 281 or the equivalent. Lectures, M W 9:05. Laboratory, M or W 10:10–12:35.

C. H. Uhl. Alternates with Poultry Science 419. Not offered in 1974–75.
Deals mainly with the cellular mechanisms of heredity and including recent researches in cytology, cytogenetics, and cytotaxonomy.]

[441 Plant Growth and Development. Fall term. Credit three hours. Offered in alternate years. Prerequisite: course 242 or 340 and 345, or equivalent, or permission of instructor. Lectures M W F 8. P. J. Davies and D. J. Paolillo. Not offered in 1974–75.
Changes during growth and development of plants and their control: morphological and anatomical changes in apices; tissue differentiation; organ formation; embryo development; nucleic acid and protein synthesis: gene regulation; hormones—their action, mode of action, and interaction; the influence of light in development; flowering, fruiting, dormancy and abscission; reactions to stress.]

444 Comparative and Developmental Morphology of the Embryophyta. Spring term. Credit four hours. Offered in alternate years. Prerequisite: 345 and consent of the instructor. Lectures, T Th 8. Laboratory, T Th 2–4:25. D. J. Paolillo.
The life histories of bryophytes, vascular cryptograms, and seed plants are explored for their developmental attributes and for their bearing on concepts of evolution and group relationships. The course content is presented so that an awareness of the integration between morphology and other disciplines in biology can be developed.

[448 Plants and Time (paleobotany). Spring term. Credit three hours. Offered in alternate years. Prerequisite: Plant Anatomy and Plant Morphology recommended (may be concurrent), or permission of the instructor. Lectures, M W 1:25–2:20. Laboratory, M 2:30–4:25. H. P. Banks. Not offered in 1974–75.
A survey of the evolutionary history of the major groups of plants. Emphasis will be placed on a consideration of the geologic time of appearance of major innovations in the plant kingdom and their subsequent adaptive radiations.]

449 Research in Botany. Fall or spring term. Credit and hours to be arranged. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. Staff.
Students engaged in special problems or making special studies may register in this course. They must satisfy the instructor under whom the work is taken that their preparation warrants their choice of problem.

543 Plant Physiology, Advanced Laboratory Techniques. Fall term. Credit four hours. Primarily for graduate students doing work in plant physiology, but open to others if space permits. Prerequisite: organic chemistry, biochemistry, course 242 or 340, or the equivalent. Preregistration recommended. Laboratory, T or W 8–5. Recitation, M 4:30–5:30. Staff.
An introduction to some modern methods in experimental plant biology.

545 Photosynthesis. Fall term. Credit two hours. Prerequisite: Chemistry 104 or 208, Math 108 or 111, and Physics 102 or 208, or consent of the instructor. Concurrent or previous enrollment in 405 recommended. Lectures, T Th 10:10. R. K. Clayton.
A detailed study of the process by which plants use light in order to grow, emphasizing physical and physico-chemical aspects of the problem.

[547 General Photobiology. Fall term. Credit two hours. Open to undergraduate students. Prerequisite: same as for 545. Concurrent or previous enrollment in 405 recommended. Lectures, T Th 10:10. R. K. Clayton. Not offered in 1974–75.
A study of the major interactions between light and living matter as encountered in photosynthesis, vision, regulation of physiology and development, bioluminescence, and damage by ultraviolet and visible light.]

548 Aspects of Plant Metabolism. Spring term. Credit three hours. Offered in alternate years. Prerequisite: 242 or 340, and 431; Chemistry 353, or the equivalent. Lectures, M W F 9:05. A. T. Jagendorf; R. E. McCarty, J. F. Thompson, and staff.
Selected areas of plant biochemistry will be reviewed in the context of the plant life cycle and responses to the environment. Probable topics include: metabolism and storage function of lipids, carbohydrates, organic acids, proteins and pigments; nitrogen and sulfur assimilation; hormone metabolism; respiration, photosynthesis, development and replication of mitochondria and chloroplasts; cell wall composition and properties. Attention will be paid to operation of control mechanisms.

549 Transport of Solutes and Water in Plants. Fall term. Credit three hours. Offered in alternate years. Prerequisite: 340 or equivalent. Lectures, M W F 10:10. R. M. Spanswick.
Transport of ions, water, and organic materials in plants. Mechanisms of ion transport. Relationships between ion transport and metabolism. Ion uptake and transport in higher plants. Phloem transport. Water relations of single cells and whole plants.

643 Plant Physiology Seminar. Fall and spring terms. Noncredit. Required of graduate students taking work in plant physiology. F 11:15. Staff.
Lectures on current research in plant physiology presented by visitors and staff.

645 Current Topics in Plant Physiology. Fall term. Credit two hours per term. Course may be repeated for credit. Time to be arranged. Staff.
Seminar reports by graduate students, on current literature in experimental plant physiology or related areas.

647 Special Topics in Plant Taxonomy. Fall and spring terms. Credit one hour per term. Prerequisite: permission to register. Lecture and discussion. Hours to be arranged. D. M. Bates, W. J. Dress, J. W. Ingram, and H. E. Moore.
A series of four topics, one presented each term, designed to provide professional background in biosystematics, literature of taxonomic botany, nomenclature, and tropical families of phanerograms.
(*1*) Fall term, 1974. Nomenclature. An analysis of the International Code of Botanical Nomenclature and its application to various plant groups. Lectures, problems, discussion. W. J. Dress.
(*2*) Spring term, 1975. Biosystematics. A consideration of biosystematic approaches to taxonomy including chemical, numerical, cytological, and statistical methodologies as well as a review of classic studies. D. M. Bates.
(*3*) Fall term, 1975. Families of Tropical Phanerogams. The families of flowering plants encountered solely or chiefly in tropical regions will be considered in lectures, discussions, and demonstrations with the aim of providing basic points of recognition for and an understanding of diversity and relationships in these families for the student venturing into the tropics. H. E. Moore.
(*4*) Spring term, 1976. Literature of Taxonomic Botany. A survey of the basic reference works in taxonomy from the pre-Linnaean literature drawn on by Linnaeus to contemporary publications with comments on the peculiarities of the books (when appropriate) on publication dates, typographic devices, and intricacies of bibliographic citation. Lectures, demonstrations, discussions, and problems. J. W. Ingram.

649 Seminar in Systematic Botany. Fall term. Credit one hour. Course may be repeated for credit. F 1. Staff.
Lectures and discussion led by staff, visitors, and students on topics of current importance to systematic botany.

Evolution, Taxonomy, and Ecology of Vascular Plants (Biological Sciences 371, 464, 663).

Plant Ecology (Biological Sciences 463).

Advanced Mycology (Plant Pathology 579).

Taxonomy of Fungi (Plant Pathology 599).

Current Topics in Mycology (Plant Pathology 649).

Introductory Mycology (Plant Pathology 309).

Optics in Biology (Biological Sciences 405).

Ecology, Systematics, and Evolution

261 Introductory Ecology. Either term. Credit three hours. Prerequisite: college biology or a score of 5 on the advanced placement examination. Lecture: Fall W 12:20–2:30, Spring T Th 10:10–11. Special projects or discussion by arrangement. D. Pimentel and L. C. Cole.
Ecological principles studied and reinforced using current examples of environmental pollution problems and their solutions. Topics include: energy in ecological systems and the energy crisis; recycling in ecosystems and waste production and degradation; limiting factors and impact of pollutants on life; population dynamics and human numbers and world food supply; competition, predation, and parasitism and biological control; biotic communities and the natural resources; population dispersal and dispersion and social behavior; habitat systems and land and water use; succession and supply-demand economy within biotic communities and the economics of pollution control. The relationship of ecology to other sciences and need of multidisciplinary approaches to both biological and environmental problems will be emphasized.

361 General Ecology. Fall or spring term. Credit three hours. For students with concentration in ecology or related subject. Not open to freshmen. Prerequisite: 101–102 or equivalent. Lectures, T Th 9:05. Discussion, W or Th 1:25, 2:30, or 3:35. P. P. Feeny and P. L. Marks.
Principles concerning the interactions between organisms and their environment. Influence of competition, social behavior, predation, and other factors of population size and dispersion. Role of energy flow and mineral cycling in determining the structure and productivity of ecosystems. Succession and classification of natural communities. Influence of climate and past events on the diversity and stability of communities in different regions of the world. Interspecific competition and the niche concept. Chemical interactions between organisms. Application of ecological principles to human problems. Modern evolutionary theory will be stressed throughout and attention given to conflicting ecological hypotheses.

364 Introduction to Marine Science. Summer, by special application. Credit five hours. S-U grades only. Prerequisite: a full year of college biology or geology. A special course offered at the Shoals Marine Laboratory of Cornell University, Appledore Island, Isles of Shoals, off Portsmouth, New Hampshire. The faculty includes up to fifty lecturers from academic institutions, marine industry, governmental agencies, and fishermen. J. M. Kingsbury and staff.

Living material and habitats are emphasized in introducing students to the major disciplines of marine biology and oceanography and in rounding out the student's knowledge of these topics as presented at inland locations. Shipboard demonstrations of oceanographic tools and techniques are conducted, and the North Atlantic fisheries are examined with the participation of commercial trawlers and fishermen from the Gloucester fleet and the National Marine Fisheries Service.
Presented cooperatively by Cornell University, the University of New Hampshire, and the State University of New York, and carries transcript credit at the participating universities. For more details see the *Announcement of the Summer Session;* for information and applications, consult the Office of Marine Biology, 202 Plant Science Building.

371 Taxonomy of Vascular Plants. Fall term. Credit four hours. Prerequisite: 281 or permission of the instructor. Lectures and discussions, T Th 9:05. Laboratory, T Th 2–4:25. R. T. Clausen.
An introduction to the evolution and classification of vascular plants, with attention to principles, methods of identification, and literature. In the first part of the term, trips are held in laboratory periods.

373 The Vertebrates. Fall term. Credit five hours. Laboratory enrollment limited to twenty each section. Prerequisite: 101–102 or equivalent. Lectures, T Th 10:10. Laboratory, M W 1:25–5; T Th 1:25–5; M 7–10 p.m., F 1:25–5; T Th 7–10 p.m. One preliminary examination will be given at 7:30 p.m. Midterm examination will be given in the evening. Time to be announced. W. M. Howell and W. N. McFarland.
An introduction to the evolution, classification, comparative anatomy, life history, and behavior of vertebrate animals. Laboratory dissection, experimentation, and demonstration are concerned with structure, classification, systematics, biology of species, and studies of selected aspects of vertebrate life.

461 Oceanography. Fall term. Credit three hours. Prerequisite: 361, 261, or consent of the instructor. Lectures, T Th 10:10. Additional lectures, Th 12:20 alternating with laboratory, M T W or Th 2:30–5. J. P. Barlow.
Physical and chemical aspects of the marine environment and interactions with marine communities. Laboratories devoted to demonstrations of field and laboratory techniques, experiments with simple models, and interpretation and analysis of typical oceanographic data.

462 Limnology, Lectures. Spring term. Credit three hours. Prerequisite: 361, 261, or permission of instructor. Lecture, M W F 11:15. G. E. Likens
A study of the interaction of biological communities and their aquatic environment. Lectures deal with the physical, chemical, and biological dynamics of freshwater ecosystems.

463 (462A) Limnology, Laboratory. Spring term. Credit two hours. Prerequisite: concurrent enrollment in 462. Laboratory, W Th or F 1:25–5:25. One all-day field trip. G. E. Likens.
Laboratories devoted to both field studies and experiments on model ecosystems.

464 (463) Plant Ecology. Fall term. Credit three hours. Prerequisite: two advanced-level courses in biology including B.S. 361, or consent of instructor. Lectures, M W F 11:15. Field trips, F 12:20–5. P. L. Marks and R. H. Whittaker.
Principles of plant-environment interactions in relation to the distribution, structure, and functioning of plant communities. These principles will be illustrated by analysis in the field of representative plant communities and their environments.

465 (463A) Plant Ecology, Laboratory. Fall term. Credit one hour. Prerequisite: concurrent enrollment in Biological Sciences 464 or an equivalent background in plant ecology. Laboratory, F 12:20–5. Limited to twenty students. P. L. Marks and R. H. Whittaker.
Laboratory and field exercises in plant ecology. Field study of plant communities and techniques for the analysis of community data are emphasized.

466 (464) Evolution and Ecology of Vascular Plants. Spring term. Credit four hours. Prerequisite: 371 or permission of the instructor. Lectures and discussions, T Th 9:05. Laboratory, T Th 2–4:25. R. T. Clausen.
A study of the variation, evolution, and ecological distribution of vascular plants. Laboratory periods in the later part of the term are devoted to study of natural populations in the field.

467 (466) Chemical Ecology. Spring term. Credit two hours. Primarily for seniors and graduate students. S-U grades optional. Offered in alternate years. Prerequisite: Chemistry 353 or 357–358, course 101–102 or permission of instructor. Lectures, M F 12:20. P. P. Feeny; M. Alexander, T. Eisner, J. Meinwald, W. L. Roelofs, and R. H. Whittaker. Offered in alternate years. Not offered in 1975–76.
Ecological and evolutionary significance of chemical interactions of organisms. Summary of key processes in regulation of natural populations. Survey of major classes of natural products with emphasis on appropriate analytical techniques. Chemical adaptations for reproduction, defense, habitat selection, dispersal, feeding efficiency and competition in animals, plants, and microorganisms. Choice of adaptive strategy in relation to energy flow. Practical applications of chemical ecology.

468 (467) Species Distribution and Abundance. Fall term. Credit three hours. Prerequisite: 361; introductory statistics strongly recommended. Lecture, T Th 1:25–2:20. Laboratory, T 2:30–4:30. P. F. Brussard.
An advanced course emphasizing the unifying principles of ecology, biogeography, and population biology. Topics include the distribution of organisms in time and space, biogeographic regions, continental and island patterns of distribution, ecology of dispersal and colonization, ecological and genetic considerations of population structure, and factors determining population size. Includes projects and exercises designed to give students firsthand contact with field techniques and data analysis.

[470 Ichthyology. Spring term. Credit five hours. Prerequisite: 373, 469, and permission of instructor. Lectures, M W 9:05. Laboratory, T Th or W F 1:25–4:25. Offered in alternate years. W. M. Howell. Not offered in 1974–75.
Lectures on advanced aspects of the biology of fishes including systematics, ecology, life history, and literature. Laboratory studies of the orders, major families, and principal genera, and of systematic procedures. Field studies of the ecology and life history of local species.]

471 Mammalogy, Lectures. Fall term. Credit three hours. Prerequisite: 101–102; Lectures, T Th S 10:10. J. W. Hudson and M. E. Richmond.

472 (471A) Mammalogy, Laboratory. Fall term. Credit two hours. Prerequisite: concurrent enrollment in 471. Laboratory, T Th or W F 1:25–4:25. J. W. Hudson and M. E. Richmond.
Laboratory and field work on ecology, behavior, physiology, and the taxonomy of recent mammals, with emphasis on the North American fauna.

473 (472) Ornithology. Spring term. Credit four hours. Prerequisite: 373 or equivalent work in vertebrate biology and permission of instructor. Lectures and Laboratories, T Th 12:20–4:25. T. J. Cade.
Lectures cover various aspects of the biology of birds, including anatomy, physiology, classification, evolution, migration and orientation, behavior, ecology, and distribution and are fully integrated with laboratory studies. Laboratory includes studies of external and internal morphology, pterylosis, molts and plumages, specimen identification of birds of New York, and families of birds of the world. Several demonstration periods emphasize hybridization, evolution, adaptive radiation, mimicry, and geographic variation. Occasional field trips and special projects are also included.

[474 Herpetology. Spring term. Credit five hours. Prerequisite: 373 or equivalent experience in vertebrate zoology. Lectures M W F 10:10. Laboratory, Section 1 M W 1:25–4:25. Laboratory, Section 2 T Th 1:25–4:25. In addition, there are several required evening field trips and at least one Saturday field project. Some of the laboratory work requires measurements to be made at intervals during the day and evening. Each laboratory section limited to 12 students. Stimson 318. F. H. Pough. Not offered in 1974–75.
Lectures on the evolution, distribution, and adaptations of reptiles and amphibians. Emphasis on zoogeography, ecology, behavior, and physiology. Laboratory and field work on systematics, ecology, behavior, and physiology.]

[475 (474A) Herpetology Lectures. Spring term. Credit three hours. Prerequisite: permission of instructor. F. H. Pough. Not offered in 1974–75. The lecture portion of 474.]

476 (475) Organic Evolution. Fall term. Credit four hours. Prerequisite: 281 and a working knowledge of elementary algebra and logarithms. Also desirable is a course with some taxonomic content in botany or zoology, or experience in making and maintaining a collection of some plant or animal group. Lectures, T Th 11:15. Lecture or discussion, Th 12:20 and optional discussion one evening session each week, to be arranged. Staff.
Lectures and class discussions on organic evolution, with primary emphasis on the mechanisms of animal speciation and adaptation. The course begins with a few lectures on taxonomic methodology.

477 (468) Biology of Fishes, Lectures. Spring term. Credit three hours. Prerequisite: 373 or equivalent experience in vertebrate zoology with permission of the instructor. Lectures, M W F 9:05. Offered in alternate years. W. M. Howell.
An introduction to the study of fishes; their structure, classification, evolution, distribution, ecology, physiology, and behavior.

478 Biology of Fishes, Laboratory. Spring term. Credit two hours. Prerequisite: 373 or equivalent and concurrent enrollment in 469. Laboratory, T Th or W F 1:25–4:25 (plus irregular hours as required for experiments and some required field trips). Offered in alternate years. W. M. Howell.
Laboratory work on structure, identification, ecology, physiology, and behavior of fishes, with emphasis on local species.

479 Research in Ecology, Evolution, and Systematics. Fall or spring term. Credit and hours to be arranged. Undergraduates must attach to their preregistration material written permission from the section chairman and faculty who will supervise the work and assign the grade.
Practice in planning, conducting and reporting

independent laboratory and/or library research programs.

[561 Quantitative Ecology. Fall term. Credit four hours. Prerequisites: one year of biology and permission of instructor. Organic chemistry and some college mathematics are desirable. Lectures, T Th S 11:15. Laboratory, W 1:25–4:25. L. C. Cole. Not offered in 1974–75.
A quantitative course on selected ecological topics for advanced undergraduates and students. Topics include the origin and interpretation of habitat differences, toleration and response physiology, population dynamics, construction and uses of life tables, spatial distribution patterns, and approaches to the quantitative analysis of biotic communities.]

562 Ecology of Pest Management. Spring term. Credit three hours. Registration by permission. Lectures T Th 11:15. Special problem required. D. Pimentel and staff.
The focus will be on the ecology of pest management for the development of safe, economical population control measures. The "systems approach" to the management of pests (insects, algae, weeds, animal and plant pathogens, birds, and mammals) will be emphasized.

565 Limnology Seminar. Fall term. Credit one hour; may be repeated for credit. Primarily for graduate students. Prerequisite: consent of instructor required for undergraduates. Hours to be arranged. G. E. Likens.
A seminar course on advanced limnological topics.

566 Marine Ecology. Spring term. Credit three hours. Enrollment limited. Prerequisites: 361, 461. Lectures, M W 9:05. Additional lecture, F 9:05 alternating with laboratory. Laboratory time to be arranged. J. P. Barlow.
Lectures will present a survey of current topics in biological oceanography, including biogeography, ecosystems, marine resources and environmental problems. Laboratory will consist of demonstration of common chemical and biological methods, with the last few weeks devoted to interpretation of typical oceanographic data.

571 Special Topics in Higher Vertebrates. Fall term. Credit two hours. Enrollment limited. Prerequisite: advanced courses in vertebrate biology and permission of instructor. Hours to be arranged. T. J. Cade and J. W. Hudson.
Seminars in selected topics of vertebrate ecology, behavior, physiology, and systematics with an emphasis on review of current literature.

573 Special Topics in Lower Vertebrates. Fall term. Credit two hours. Prerequisite: consent of instructor. For advanced students in biological sciences. Hours and topics to be arranged. W. N. McFarland and F. H. Pough. Offered in alternate years.
Seminars in selected topics in the biology of fishes, amphibians, and reptiles. Topics vary from year to year.

661 Seminar in Population and Community Ecology. Fall term. Credit one hour. Course restricted to graduate students. Prerequisite: permission of instructor. Lecture, T 4:30. May be repeated for credit. P. F. Brussard, S. A. Levin, and R. B. Root.

663 Seminar in Evolution and Ecology of Vascular Plants. Fall term. Credit one hour. Prerequisites: 464 and Statistics 510 and 511 or equivalent, or permission of instructor. Lecture and discussion, M 11:15. R. T. Clausen.
A consideration of primary problems concerned with the classification, evolution, and environmental relationships of vascular plants.

[665 Autecology. Fall term. Credit three hours. Lectures M W 8–9:55. B. F. Chabot and staff. Offered in alternate years. Not offered in 1974–75.
Comparison of the responses and adaptations of organisms to environment in selected ecosystems. Emphasis on similarities and differences in molecular and organismal mechanisms by which plants and animals cope with their environments.]

[666 Population Ecology. Spring term. Credit three hours. Prerequisite: graduate standing with some background in calculus, statistics, ecology, and evolutionary theory plus consent of instructor. Lectures and discussions, M W 8–9:55. P. F. Brussard, L. C. Cole, and S. A. Levin. Offered in alternate years. Not offered in 1974–75.
Critical examination of the properties and dynamics of populations. Emphasis on theories of population structure, dynamics, and regulation. Discussion of experimental approaches to analyses of natural populations.]

667 Community Ecology. Fall term. Credit three hours. Prerequisite: 666 or permission of instructor. Lectures, T Th 10:10–12:05. J. P. Barlow and R. H. Whittaker. Offered in alternate years. Not offered in 1975–76.
The structure and dynamics of natural communities; patterning and sampling problems, species-diversity, gradient relations, succession, and classification. Comparative aspects of terrestrial, marine, and freshwater communities will be stressed.

668 Ecosystems. Spring term. Credit three hours. Prerequisite: 667 or permission of instructor. Lectures, T Th 10:10–12:05. G. E. Likens and P. L. Marks. Offered in alternate years. Not offered in 1975–76.
Analysis of ecosystems in terms of energy flow,

materials circulation, and model systems; biogeochemistry, pollution, and human ecology. Emphasis on the functional properties of ecosystems considered from simple systems to the biosphere as a whole.

669 Plant Ecology Seminar. Fall and spring terms. Credit one hour. S-U grades only. Suggested for students majoring or minoring in plant ecology. Hours to be arranged. B. F. Chabot and P. L. Marks.
A seminar course including review of current literature, student research, and selected topics of interest to participants.

Insect Biology (Entomology 212).

Invertebrate Zoology (Biological Sciences 316).

Advanced Soil Microbiology (Agronomy 506).

Soil Microbiology Lectures (Agronomy 306).

Soil Microbiology Laboratory (Agronomy 307).

Microbial Ecology Microbiology (Biological Sciences 492).

Phycology (Biological Sciences 344).

Bionomics of Fresh-Water Invertebrates (Entomology 471).

Introductory Insect Taxonomy (Entomology 331).

Advanced Insect Taxonomy (Entomology 531, 532, 533, 534).

Introductory Parasitology (Entomology 361).

Advanced Parasitology (Entomology 551).

Ecological Aspects of Animal Behavior (Biological Sciences 523).

Genetics, Development, and Physiology

280 Human Genetics. Spring term. Credit three hours. Prerequisite: 101–102 or 109–110 or equivalent. Students who have taken 281 may register only with permission of the instructor. Lectures, M W 10:10. Discussion, Th one section 10:10 or two sections 11:15 or F four sections 10:10 or one section 11:15. Limit of 25 each section. A. M. Srb.
An introduction to biological heredity through consideration of the genetics of man. Advances in the science of genetics are having a profound effect on man's understanding of himself and on his potential for influencing his present and future well-being. The course is intended primarily to contribute to the student's general education in these matters and, although certain aspects of genetics will be considered with some rigor, the course is not designed to serve as a prerequisite to advanced courses in genetics.

281 (281A–281B) Genetics, Lectures. Fall or Spring terms. Credit five hours. Prerequisite: 101–102 or 105 or equivalent. Students who have taken 280 may register only with permission of the instructor. No freshman will be allowed in fall semester. Lectures, M W F 8. Preliminary examinations may be scheduled in the evening. Laboratory, M T W Th or F 2:30–4:25, T or Th 8–9:55, or S 10:10–12:05. (Laboratory sections may also be scheduled W or F 10:10–12:05 if enrollment exceeds 240 students.) P. Bruns (Fall), G. R. Fink (Spring), R. J. MacIntyre (Laboratory), and assistants.
A general study of the fundamental principles of genetics in eucaryotes, procaryotes, and viruses. Discussions of gene transmission, gene action and interaction, gene linkage and recombination, gene structure, gene and chromosome mutations, genetic aspects of differentiation, genes in populations, breeding systems, extrachromosomal inheritance. In the laboratory, students perform experiments with microorganisms and conduct an independent study of inheritance in Drosophila. Students do not preregister for laboratory sections. Laboratory assignments will be made at the end of the first lecture period.

386 Animal Embryology. Spring term. Credit four hours. Enrollment limited to eighty students. Prerequisite: 281. A background in vertebrate anatomy or histology desirable. Lectures, W F 9:05. Laboratory, W and F 10:10–12:35 or 2–4:25. Staff.
Introduction to general animal embryology with major emphasis directed to vertebrates. The lectures cover the physiological, genetical, and morphological bases of early development. The laboratories have a strong anatomical theme.

387 Molecular Aspects of Development. Fall term. Credit three hours. Prerequisite: 281, 431, highly recommended. Lectures, M W F 9:05. R. L. Hallberg.
Analysis at the cellular and subcellular level of the regulation of the synthesis and activity of gene products in the development of eucaryotes. Selected systems will be discussed which demonstrate the differential regulation of nucleic acid and protein synthesis within individual cells as well as between different populations of cells within a developing organism. Sufficient emphasis will be placed on technological methodology in order that current research papers in molecular cell biology can be critically analyzed.

480 Population Genetics. Spring term. Credit three hours. S-U grades optional. Offered in alternate years. Prerequisite: 281 or equivalent.

Lectures, T Th 11:15. B. Wallace.
A study of factors which influence the genetic structure of Mendelian populations and which are involved in race formation and speciation. In contrast with 484, this course deals largely with the algebraic aspects of population genetics.

484 Molecular Evolution. Spring term. Credit three hours. Offered in alternate years. Prerequisites: 281 and organic chemistry. Lectures, T Th 11:15. R. J. MacIntyre.
An analysis of evolutionary changes in proteins and nucleic acids and gene-enzyme variability in natural populations. The role of natural selection in effecting these changes and maintaining genetic variation at the molecular level will be critically examined. Theories on the evolution of the genetic code and the construction of phylogenetic trees from biochemical data will be discussed.

485 (485A) Microbial Genetics, Lectures. Fall term. Credit two hours. S-U grades optional. Prerequisites: 281 and Microbiology 290A, or permission of the instructor. For upperclassmen and graduate students. Lecture, W 7:30–9:25 p.m. S. A. Zahler.
Genetics of bacteria and their viruses, with emphasis on the mechanisms of genetic phenomena.

486 (485B) Microbial Genetics, Laboratory. Fall term. Credit three hours. Prerequisites: 485A (may be taken concurrently) and permission of the instructor. Primarily for upperclassmen. Laboratory, T 1:25–4:25, and four other hours to be arranged. S. A. Zahler.
Problem solving in bacterial genetics.

488 Genetics of Lower Eucaryotes. Spring term. Credit three hours. S-U grades optional. Prerequisites: 281 and a course in organic chemistry. Lectures, M W 9:05. P. J. Bruns, G. R. Fink, and A. M. Srb.
Genetic aspects of the biology of a few eucaryotic microorganisms, primarily yeast, Neurospora, and ciliated protozoa, with emphasis on the use of these organisms as experimental tools. Major topics to be covered include gene action, control mechanisms, cytoplasmic genetic systems, recombination and conversion, morphogenetic systems and evolutionary aspects of physiological systems. Extensive appropriate reading in the original literature of genetics is a primary component of the course.

489 Research in Genetics and Development. Fall or spring term. Credit and hours to be arranged. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. Staff.
Practice in planning, conducting, and reporting independent laboratory and/or library research programs.

680 Current Topics in Genetics. Throughout the year. Credit two hours a term. Open to graduate students, with preference given to majors in the Field of Genetics; undergraduates by permission only. No auditors. Enrollment limited to 20 students. Time to be arranged. Staff.
A seminar course with critical presentation and discussion by students of original research papers in a particular area of current interest. Content of the course and staff direction will vary from term to term, and will be announced a semester in advance.

Animal Cytogenetics (Poultry Science 419).

Cytology (Biological Sciences 347).

Cytogenetics (Biological Sciences 440).

Organic Evolution (Biological Sciences 475).

Physiological Genetics of Crop Plants (Plant Breeding 505).

Plant Growth and Development (Biological Sciences 441).

Statistical Methods I (Statistics 510).

Communication Arts

Communication Theory

150 Introduction to Communication. Fall term. Credit three hours. Limited to Communication Arts freshmen and first-year transfer students. T Th 9:05. F 12:20. N. E. Awa and staff.
Designed to introduce majors to the field of communication with a view to giving them a basic foundation in the various areas and dimensions of the field, as well as an under-

standing of their interrelations. The course includes the major spectrums of human communicative effort: oral, written, visual, nonverbal, mass media technology, theory, international communication, and communication law.

200 Theory of Human Communication. Fall or spring term. Credit three hours. S-U grades optional. Lecture, T Th 10:10. Discussion, T or Th 12:20. J. A. Barwind.
Introduction to behavioral theories of communication from a multidisciplinary perspective. Contributions from the mass media, anthropology, sociology, psychology, social psychology, rhetoric, and cybernetics are considered.

403 Topics in Communication Theory. Fall term. Credit three hours. Prerequisite: 200 or consent of instructor. M W F 9:05. J. A. Barwind.
Specific topics will vary from semester to semester but generally will be drawn from such areas as communication between polarity groups, roleplaying and communication, therapeutic communication, nonverbal communication, effects of status on communication patterns and networks, interpersonal influence and person perception, mass persuasion, general semantics, rumor transmission, propaganda, etc. Specific variables in these areas will be discussed with particular reference to their effects on the process of communication.

404 Psychology of Communication. Spring term. Credit three hours. Prerequisite: 200 or consent of instructor. M W F 9:05. J. A. Barwind.
An advanced study of communication theory from a multidisciplinary orientation. Topics to be covered include: interpersonal interaction, channels of communication, and effectiveness of message. Study will include intensive analysis of primary sources of major communication theorists.

Interpersonal Communication

205 Parliamentary Procedure. Fall or spring term. Credit two hours. Not open to freshmen. Limited to 20 students. Th 2–4:25. Staff.
Principles and practice of parliamentary procedure including formation of by-laws, and meeting evaluation. Programmed instructional materials used. Emphasis on experience in applying principles of parliamentary procedure in meeting situations.

301 Oral Communication. Fall or spring term. Credit three hours. Limited to juniors and seniors. Each section is limited to 24 students. Fall term: M W F 8, 9:05, 10:10, 11:15 or T Th 9:05 or 10:10 and W 12:20. Conferences daily 8–5. N. E. Awa, B. O. Earle, C. H. Freeman and staff.
Training and experience in the theory, preparation, presentation, and evaluation of oral topics. Designed to encourage interest in public affairs and to develop self-confidence. Individual appointments are scheduled to counsel the students in principles of effective oral communication.

302 Persuasion. Spring term. Credit three hours. Prerequisite: 301. M W F 11:15. Conferences by appointment, daily 8–5. Staff.
The course will concentrate on persuasion in various interpersonal settings. Oral presentations will stress the theory of persuasion.

303 Small Group Communication. Spring term. Credit three hours. Open to juniors and seniors only. Prerequisite: 200 or permission of instructor. M W 12:20–1:45. N. E. Awa.
Theory and practice in leadership and participation in small group communication. The course examines the values and limitations of group discussion, collaborative behavior and conflicts in a democracy.

Mass Media

210 Communicating Public Service Information. Fall term. Credit three hours. For non-Communication Arts majors. M W F 8. J. E. Lawrence.
Examines concepts, methods, techniques, and processes for communicating information to the general public. Explores use of public service time and space through broadcasting, films, publications, and other outlets. Emphasis on basic understanding of media requirements and procedures on disseminating public service information. Students will design information programs.

214 History of Mass Communication. Spring term. Credit three hours. S-U grades optional. Limited to 100 students. Lecture, M W 10:10. Discussion, F 10:10 or 11:15. R. H. Crawford.
A survey of the history of the print, film, and broadcast media with particular emphasis on the United States. Includes an analysis of the sociological and technological factors influencing media development.

215 Introduction to Mass Media. Fall term. Credit three hours. S-U grades optional. Limited to 190 students above the freshman level. M W F 11:15. C. C. Russell.
Introduction to policies, philosophies, and practices of communication media. Freedom of the press, ethics, libel, and slander are considered in the day-to-day function of the media.

311 Radio and Television Communication. Fall term. Credit three hours. Limited to forty students. Prerequisite: 200. T Th 9:05. Laboratory, W 1:25–3:25. R. D. Colle.
Study of the problems of access to—and designing content for—radio and television. Includes analysis of program formats.

312 Advertising and Promotion. Spring term. Credit three hours. S-U grades optional. Limited to 190 students at the junior, senior, and graduate level. M 1:25–4:25. C. C. Russell.
Examines advertising principles and techniques in both a historical and an economic perspective. Advertising and promotion campaigns and their overall effectiveness as a multiplier in the economy are analyzed. Current advertising trends and the strategy of media planning are examined.

401 Communication Law. Spring term. Credit three hours. Enrollment limited to majors at the junior, senior, and graduate levels, and others by permission. M W F 11:15. D. M. Provine.

Writing for the Media

313 Writing for Magazines. Fall term. Credit three hours. Open to juniors, seniors, and graduate students. T 1:25–4:25. W. B. Ward.
Intensive fact-writing to help students communicate more effectively through the medium of the printed word in magazines. Art and techniques of good writing studied; continuous analysis of magazines in many fields of interest. All articles analyzed and returned to each student for rewriting and submission to a magazine.

315 News Writing and Analysis. Fall term. Credit three hours. Limited to thirty students. Lecture, T Th 11:15. Laboratory, M 1:25–3:20. H. Kim.
The writing and analysis of news stories. A study of press problems, press-society relations, the elements that make news, sources of news, interviewing, writing style and structure, and the reporting of public affairs. Reasonable typing ability is essential for the laboratory work.

316 Science Writing. Spring term. Credit three hours. M W F 9:05. H. Kim.
In-depth interpretation of scientific subjects for general publications. The translating of scientific language to the degree necessary for reaching various publics. Analysis of issues that arise in general reporting of the news of science. Previous writing courses and/or experience are strongly recommended.

318 Radio Writing and Production. Spring term. Credit three hours. S-U grades optional. Prerequisite: 311. T 1:25–4:25. R. D. Colle.
Writing for various radio formats, with emphasis on public affairs programs, including documentaries and interviews. Students will tape record their programs for possible use on radio stations in the state.

319 Television Writing and Production. Fall term. Credit three hours. S-U grades optional. Limited to twenty-five students. Prerequisite: 311. Th 1:25–4:25. R. D. Colle.
Emphasis will be on creating several kinds of programs whose objective is to inform, educate, or persuade. Students will write and produce their own television programs which will be video-taped for playback and analysis.

420 Media Laboratory. Fall term. Credit two hours. Prerequisite: Either 313, 315, 316, 318, 319, or 431. Open to majors at junior and senior levels. Th 1:25–4:25. R. D. Colle and J. E. Lawrence.
Provides realistic media production experience such as writing, editing, and publishing the *Cornell Countryman;* and production of television and radio programs for various audiences.

421 Media Laboratory. Spring term. Continuation of 420.

Visual Communication

430 Visual Communication. Fall term. Credit three hours. Open to juniors, seniors, and graduate students. M W F 10:10. V. R. Stephen.
Explores the importance of graphic arts for communicating ideas in today's visually oriented society. Examines the principles of visual communication as related to message content. Still photography, slide sets, motion pictures, TV, posters, exhibits, and other media are analyzed.

431 Art of Publication. Spring term. Credit three hours. Open to juniors, seniors, and graduate students. W 1:25–4:25. H. Kim.
Designed to explore creative visual concepts to increase communication effectiveness through the printed word. Importance of selecting and coordinating format, layout, typography, and illustrations is stressed. Lectures, field trips, and assignments examine merits and problems in using publications as a communication medium.

440 Photo Communication. Fall or spring term. Credit three hours. Limited to 25 juniors and seniors. Priority given to Communication Arts majors. Others by permission of instructor. Fall term: Th 1:25–4:25. Spring term: T 1:25–4:25. C. H. Freeman.
Basic photography: camera handling, film processing, contact proofs, projection printing, and photographic lighting. Photojournalism will be emphasized during the latter part of the course. Designed for those with limited experience in photography. Students will be expected to furnish their own supplies and cameras.

International Communication

524 Communication in the Developing Nations. Fall term. Credit three hours. Open to seniors and graduate students. W 1:25–4:25. R. H. Crawford.
An examination of existing communication patterns and systems and their contributions to the development process. Special attention is

given to the interaction between communication development and national development in primary agrarian societies

526 Comparative Mass Media. Spring term. Credit three hours. M 1:25–4:25. H. Kim.
A comparative analysis of mass media systems in several selected national as well as sociocultural settings. The practice and behavior of the media are examined against ideological, legal, and historical backdrop. Attempt is made to systematize common referents as well as some salient factors that lie outside of comparison.

Communication Seminars

501 Intercultural Communication. Spring term. Credit three hours. T 1:25–4:25. N. E. Awa.
A systematic analysis of sociocultural and psycholinguistic obstacles to effective communication between cultures, subcultures, ethnic and identity groups. Also examined are the subtleties and complexities of nonverbal behavior in cross-cultural transactions. The role of communication in the transfer of technology is assessed in a cultural context. Examples are drawn from (1) ethnolinguistic and cross-cultural studies, (2) Peace Corps experience, and (3) programs of change crossing cultural boundaries.

512 Seminar: Interpersonal Communication. Spring term. Credit three hours. W 1:25–4:25. J. A. Barwind.
A study of recent advances and research in leadership, small-group interaction, and communication networks. New developments will be examined as they relate to business, administration, and education.

521 Seminar: United States Communication. Fall term. Credit three hours. Open to graduate students; others by permission. W 1:25–4:25. H. Kim.
An examination of the structure of communication in the United States focusing particularly on the organization, content, controls and audience of the print, broadcast, and film media. Selected media of other nations are included in the analysis to provide a perspective on the United States system.

531 Studies in Communication. Fall term. Credit three hours. Limited to 15 students. Open to graduate students in communication arts; others by permission. M 1:25–4:25. R. H. Crawford.
A review of classical and contemporary research in communication, key concepts, and areas of investigation. Exploration of the scope of the field and the interrelationships of its various branches.

532 Methods of Communication Research. Fall term. Credit three hours. T 1:25–4:25. Limited to graduate students. J. A. Barwind.
An analysis of the methods employed in communication research. Particular emphasis is placed on understanding the rationale for experimental, descriptive (empirical and non-empirical), and historical-critical research methods.

540 Special Problems in Communication. Spring term. Credit three hours. M 1:25–4:25. R. H. Crawford.
Each year discussion will focus on a particular problem or topic of special concern in society. Communication aspects will be analyzed, and present and proposed communication efforts in the area will be explored. Emphasis will be on the application of communication principles to solutions. Topics will vary from year to year, but will generally be drawn from such areas as ecology, family planning, consumer affairs and extension systems.

543 Frontiers in Communication. Spring term. Credit three hours. Th 1:25–4:25. R. D. Colle.
A study of recent developments in communication. Emphasis is on the creative application of the newest methods, materials, and technology in visual, print, film, oral, and telecommunication media to contemporary and future problems involving communication.

550 Advanced Communication Seminar. Spring term. Credit three hours. M 7–10. W. B. Ward.
Designed to give graduate students the opportunity to study and work on special problems in communication.

590–591 Communication Teaching Laboratory. Fall or spring terms. Credit three hours. Time to be arranged. Enrollment limited to graduate students in the Department of Communication Arts and senior majors by special arrangement. Prerequisite: The permission of the staff member who will supervise the work and assign the grade.
Designed primarily for students who wish to gain experience in teaching communication courses. Students will work with an instructor in the development of course objectives, philosophy, and planning as well as aiding with actual instruction.

Research

380 Independent Honors Research in Social Science. Throughout the year. Credit one to six hours. Open only to candidates who have met the requirements for the Honors program.
A maximum of six credits may be earned in the Honors program.

495 Independent Research. Fall and spring terms. Credit one to three hours. Open to

seniors and graduate students in Communication Arts. Seniors must attach to their preregistration material written permission from the staff member who will supervise the work and assign the grade. Designed to permit outstanding students to carry out independent studies in communication research under appropriate supervision. Departmental staff.

595 Directed Graduate Study. Fall and spring terms. Credit three to six hours. Staff.

Education

110 General Psychology. Fall or spring term. Credit three hours. May not be taken for credit by students who have had Psychology 101 or equivalent. Two lectures, a testing and demonstration period, and one discussion section each week. Lecture and testing period, M W F 10:10. Discussion sections, Th or F 8, 9:05, 10:10, 11:15, 12:20, 1:25, 2:30, or 3:35. G. W. McConkie.
A survey of research and theories in the field of psychology. Areas of emphasis include research methods, perception, learning and memory, language and thought, motivation and emotion, individual differences and psychological testing, personality development, and abnormal psychology.

240 The Art of Teaching. Spring term. Credit three hours. S-U grades optional. T Th 1:25–2:40. G. Posner.
Views teaching as an activity that occurs throughout life and in an infinite variety of situations. Criteria of good teaching and varieties of teaching styles are examined. Primarily an experiential exploration of teaching, most of the student's time being spent watching people teach, describing what they observe, and discussing their observations.

270 Educational Studies. Fall term. Credit three hours. M W 9:05, one hour to be arranged. K. A. Strike.
An introductory study of central and representative issues of policy and practice which have and are molding education in the United States.

331 Introduction to Teaching Agriculture. Spring term. Credit one hour. Required of juniors and others entering the directed teaching program in the senior or following year. M 1:25. F. K. T. Tom.
An introduction to the origin, development, objectives, course of study, and method of teaching agriculture in secondary schools, and to individual experience programs.

335 Youth Organizations. Spring term. Credit three hours. T Th 10:10 plus laboratory arranged. J. P. Bail.
The primary focus will be on the role of selected youth organizations (commonly found in many communities throughout the state and nation) in providing educational experiences for adolescents. Factors affecting membership in such organizations, including psychological, sociological, and economic will be surveyed. Emphasis will be placed on the various roles the adult volunteer leader may play. A field experience with a recognized intracurricular or extracurricular youth organization will be required of all students.

380 (380H) Independent Honors Research in Social Science. Throughout the year. Credit one to six hours. Open only to candidates who have met the requirements for the Honors Program. A maximum of six credits may be earned in the Honors Program.

401 Our Physical Environment. Fall or spring term. Credit three hours. Open by permission only. Limited to eighteen students. Lecture, T 1:25; practical exercises T 2:30–4:25 and one hour to be arranged. V. N. Rockcastle.
A study of the commonplace phenomena and substances in our physical environment, and their use in demonstrating basic scientific principles. Frequent field trips and firsthand examination will be used in studying air, water, soil, light, and sound, and some elementary mechanical and electrical devices. Emphasis will be placed on the physical environment as an aid to teaching the physical sciences in the public secondary schools.

402 Literature in Conservation and Environmental Education. Spring term. Credit two hours. Open only to students above sophomore rank. T Th 11:15. R. B. Fischer.
An examination of books, periodicals, and reports dealing with historical and present aspects of environmental quality and education. Students are involved in planning and offering the lectures, discussion, and literature reports.

403 Environmental and Natural History Writing. Fall term. Credit two hours. Open to students above sophomore rank. T Th 11:15. R. B. Fischer.
For persons who wish to improve their ability to reach and influence others by publishing in magazines and newspapers. The class produces a weekly column for a local newspaper in addition to other types of articles. Subject matter, outlets for articles, news releases, posters, newsletters, and brochures are discussed. A working knowledge of biology and ecology is assumed.

404–405 Field Natural History. Fall or spring term. Credit three hours. Limited to students above sophomore level. Permission of instructor required. Lecture, M 10:10. Weekly field trips and lecture, T or Th 1:25–4:30. R. B. Fischer.
Devoted to biology and ecology of Northeastern

plants and animals, and their use in the environmental education programs of interpretive centers, schools, and field biology courses. Man's impact on plant and animal communities is stressed.

407 The Teaching of Elementary School Science. Fall and spring terms. Credit three hours. Registration by permission. Limited to eighteen students. Lecture, W 1:25; practical exercises, W 2:30–4:25 and one period of public school classroom teaching to be arranged. V. N. Rockcastle.
The content and methods of elementary-school science with field work and laboratory emphasis on modern and experimental curricula. Includes class observation and experimentation. Designed particularly for those who are intending to teach or supervise elementary school science.

408 Methods of Teaching Science in Secondary Schools. Fall term. Credit three hours. For seniors or graduate students without teaching experience. Permission of instructor required. M W 3:35–5. Staff.
Consideration of current methodology, curricula and materials for teaching science in secondary schools.

409 Practice in Teaching Science in Secondary Schools. Fall term. Credit twelve hours. Permission of instructor. For seniors and graduate students. Hours to be arranged. Staff.
Supervised practice in teaching science.

411 Educational Psychology. Fall or spring term. Credit three hours. Prerequisite: an introductory course in psychology. Fall term: Section I, M W F 11:15. R. E. Ripple; Section II, Special section for agricultural education majors, time to be arranged. M. D. Glock. Spring term: M W F 9:05. M. D. Glock.
Designed for students in teaching programs and/or those interested in the educational process. Consideration of the outstanding facts and principles of psychology bearing upon classroom problems. In the spring term emphasis is on measurement and evaluation.

417 Psychology of Adolescence. Spring term. Credit three hours. Freshmen and sophomores not admitted. Prerequisite: an introductory course in psychology. Enrollment limited to 100 students. T Th 1:25–3:20. R. E. Ripple.
A survey of the nature of adolescent growth and development with emphasis on some of the causal factors pertaining to adolescent behavior.

432 Methods, Materials, and Directed Practice in Teaching Agriculture in the Secondary School. Fall term. Credit nine hours. Staff.
Directed participation in off-campus centers in the specific and related problems of teaching agriculture on the junior and senior high school levels which includes adjustment in the school and community; evaluation of area resources, materials of instruction, and school facilities; organization and development of courses of study; launching and directing work experience programs; planning for and teaching all-day classes; advising occupational youth organizations; and other problems relating to development of a balanced program.

433 Special Problems in Agricultural Education. Spring term. Credit one or two hours. S-U grades optional. Graduate and undergraduate. Th 1:25. Staff.
The purpose is to provide students an opportunity to study individually or as a group selected problems in agricultural education.

434 Organization and Direction of Adult Education Programs. Fall term. Credit three hours. H. R. Cushman.
Emphasis will be placed on determining instructional needs and planning programs of instruction, teaching in groups, giving individual instruction, and evaluating adult education program offerings in agricultural and occupational education.

440 Introduction to School Learning. Spring term. Credit three hours. Prerequisite: Ed. 411. M W 10:10 and one hour to be arranged. J. D. Novak.
Cognitive learning theory will be studied as a basis for analyzing various school practices. Various forms of motivation will be examined for the effects on student's development of value structures.

444 Teaching of Secondary Mathematics. Spring term. Credit three hours. Permission of the instructor required. T Th 3:35–5:15. H. A. Geiselmann.
For students who have had a basic mathematics methods course or have had some experience in teaching mathematics. Attention will be given to new materials and methodology in mathematics education. Special interests of the students will serve as a guide for the further selection of topics.

445 Teaching Reading and Study Skills. Spring term. Credit three hours. T 1:25–3:30, Olin 375. W. Pauk.
For teachers, administrators, counselors, and supervisors. Pertinent research as well as the psychology and philosophy of developmental reading and study skills will be examined. Teaching methods and sample materials for classroom use will be demonstrated and discussed.

446 General Curriculum Development. Fall term. Credit three hours. T Th 10:10–11:30. G. J. Posner, V. N. Rockcastle, and Staff.
A general "how-to-do-it" course for those interested in designing plans for teaching. Focuses on specifying educational purposes. Includes instruction in setting and refining

goals; designing content outlines; constructing behavior-content matrices, sequencing objectives; specifying behavioral evidence; and, to a lesser degree, implementation of this plan through instructional planning. Students will be expected to develop curriculum modules as a term project.

452 Interpretation of Statistics Used in Education. Fall and spring terms. Credit one hour. Registration in spring term limited to those concurrently enrolled in 453. Fall term, T 12:20. Spring term, time to be arranged. J. Millman.
A brief introduction to the vocabulary and symbolism used in reporting empirical research in education. Both univariate and multivariate statistical procedures will be covered from an intuitive point of view.

453 Introduction to Educational Statistics. Spring term. Credit three hours. Prerequisite: course 452 (may be elected concurrently), or permission of the instructor. T Th 9:05–11. J. Millman.
A study of common statistical procedures encountered in educational literature and research. The course includes the mathematical bases, computation, and interpretation of univariate and multivariate descriptive and inferential statistics.

463 (563) Sociology of Education. Spring term. Credit three hours. M W 1:25–3. E. J. Haller.
Introduction to major themes in the contemporary literature in the sociology of education. These include social stratification and education, the school as an organization and as an institution, minority groups in the school, socialization, professionalization of teaching, bureaucratization, the teacher-student roles, and the career patterns of teachers.

467 (567) Education Law. Fall term. Credit three hours. T 1:25–3:25. L. B. Hixon.
Review and analysis of federal and state legislation, court decisions, opinion, and regulations which affect public and higher institutions.

470 Issues in Educational Policy. Fall and spring terms. Credit three hours. M W F 10:10. S. Klees, K. A. Strike, F. H. Stutz.
A consideration of selected issues concerning the relation of the school to society, social and individual values, and public policy. Varying emphasis will be given to historical, philosophical, sociological, political or economic approaches depending on the instructor. Typical of the issues to be treated are equality of opportunity, alternatives in education, educational authority, and the allocation of educational resources. Especially for those intending a career in teaching.

472 Philosophy of Education. Fall term. Credit three hours. T 2:30–5. K. A. Strike.
A study of central issues in the philosophy of education. Questions of ethics, political philosophy and the theory of knowledge will be examined and the implications for education assessed.

473 Contemporary Topics in Philosophy of Education. Spring term. Credit three hours. M W 12:20–2:20. D. B. Gowin.
An intensive treatment of one or two selected topics in contemporary philosophy of education.

475 Freedom and Authority in Education. Spring term. Credit three hours. T 2:30–4:30. K. A. Strike.
An analysis of the concept of freedom in both political and psychological contexts and an application of the resulting analysis to problems of freedom and authority in education.

499 Informal Study in Education. Credit one to three hours each term. S-U grades optional. Staff.
A student may, with approval of a faculty adviser, study a problem or topic not covered in a regular course; or undertake tutorial study of an independent nature in the area of educational interests.

500 Special Studies. Fall and spring terms. Credit arranged. S-U grades optional. Staff.
Limited to graduate students working on theses or other research projects. Each registration must be approved by a staff member who will assume responsibility for the work.

507 The Teaching of Science. Fall term. Credit three hours. M 1:25–4:25. J. D. Novak.
A consideration of learning theory as applied to problems of selection and organization of subject matter, methods of teaching, and instructional innovation and of curriculum innovations that embody basic learning principles.

509 Development of Curriculum in Science. Spring term. Credit three hours. M 1:25–4:25. J. D. Novak.
Study of new science curriculum programs, including: philosophy and rationale of the programs, observation of classes using new materials, and concentrated study of science curriculum development in the area of individual student's interest. Course is conducted in a seminar style.

511 Educational Psychology. Fall term. Credit three hours. Permission of the instructor. M W F 1:25. R. E. Ripple.
A basic course in educational psychology for graduate students.

522 Educating for Community Action. Spring term. Credit three hours. Open to juniors and seniors by consent. W 11:15–1:10; F 11:15. R. L. Bruce.

Design and execution of educational aspects of community action programs. Deals with the identification and statement of educational goals, selection of teaching strategies, and evaluation of outcomes.

523 Administration of Continuing Education Programs. Spring term. Credit three hours. W 1:25–4. G. J. Broadwell.
Emphasis is on identifying, describing and analyzing alternative models for planning, organizing, staffing, directing, controlling, and financing an adult education enterprise.

524 Designing Extension and Continuing Education Programs. Fall term. Credit three hours. T 1:25–4. J. P. Leagans.
Analysis of current theories, concepts, principles, and procedures central to the process of developing programs for the continuing education of adults. Emphasis is on such problems as selecting objectives from alternatives, creating support at macro level, organizing program resources at micro level, and planning for program execution.

525 Educational Communication. Spring term. Credit three hours. T 1:25–4. J. P. Leagans.
Emphasizes the centrality of useful technology and effective communication in continuing education programs. Emerging models of the communication process are reviewed as a framework for analyzing major elements including communicator credibility, program content, messages, organization and use of transmission channels, message treatment, audience identification, feedback and the design of operation communication programs.

526 Practicum in Continuing Education. Fall and spring terms. Credit one to three hours. Hours to be arranged. Staff.
Provides opportunity for students to supplement the formal aspects of their curriculum through systematic participation in an ongoing continuing education program. Open only to graduate majors and minors in extension and continuing education.

527 Evaluation for Program Management. Fall term. Credit three hours. S-U grades optional. M 2:30–5. R. L. Bruce.
Primary attention is given to educational and other community change programs but inferences to other program management tasks are possible. The course has a series of lecture-discussions, a continuing workshop, and individual student evaluation projects.

532 Teaching Agricultural and Occupational Education. Spring term. Credit three hours. M 2:30–5. A. L. Berkey.
Consideration is given to an analysis of selected teaching techniques and to the selection, preparation, and use of instructional materials.

533 Developing Curriculum in Agricultural and Occupational Education. Fall term. Credit three hours. M 1:25–4:25. W. E. Drake.
Guiding principles, objectives, and sources of information will be developed for planning the curriculum. Consideration will be given to functions of occupational experience programs and how they are planned, developed, and used as a means of instruction.

534 Leadership of Adult Education Programs. Fall term. Credit three hours. F 1:25–3:20. H. R. Cushman.
Three alternative procedural models for organizing and conducting adult occupational education courses will be presented. Emphasis will be placed on guidelines and procedures for implementing the models in secondary and postsecondary school settings.

535 Teacher Preparation in Agriculture. Fall term. Credit three hours. W 1:25–4:25. F. K. T. Tom.
Open to persons with teaching experience in agriculture who are preparing for or are engaged in the preparation of teachers or related educational service.

536 Administration and Supervision of Occupational Education Programs. Spring term. Credit three hours. Offered in alternate years. W 2:30–4:25. J. P. Bail.
The practices followed and problems faced in the administration and supervision of occupational programs at the secondary and postsecondary level will be stressed. Attention will be given to the role of the occupational director and supervisor in program planning and implementation. Open to students with experience in teaching, industry, or related work.

539 Evaluating Programs of Occupational Education. Spring term. Credit three hours. Offered in alternate years. Open to students with experience in teaching or by permission only. T 1:25–3:20. W. E. Drake.
Students will study objectives and evaluative criteria and develop procedures for evaluation of programs of occupational education in secondary and postsecondary schools.

545 The Curriculum. Fall term. Credit three hours. M W 10:10–11:30. G. J. Posner.
An examination of the basic elements involved in making curriculum decisions and an analysis of current approaches to curriculum.

547 Career Education. Fall term. Credit three hours. M 3:35–6. S-U grades optional. J. Wilcox.
Current problems and research in career education.

551 Educational Measurement. Spring term. Credit three hours. Permission of the instructor required. T 1:25–4:25. M. D. Glock.
Study of construction of achievement tests and

use of other measuring instruments in the classification and guidance of pupils for improvement of instruction.

555 Use and Interpretation of Standardized Tests. Fall term. Credit three hours. Th 3:35–6. H. G. Andrus.
Open to students in counseling or personnel administration and to classroom teachers who expect to work with standardized group tests. Deals with the use and interpretation of tests in the evaluation of instruction or as a basis for guidance and selection in public schools, college and/or industry.

561 Administration of Educational Organizations. Fall term. Credit three hours. W 3:35–6. E. J. Haller; J. R. Egner.
A consideration of current approaches to understanding administration and organizations, and their application to the educational setting.

562 The Principalship. Spring term. Credit three hours. For graduate students only. Th 3:35–6. L. B. Hixon; J. R. Egner.
Organized to enable recognition and cognition of the administrative functions essential to effective elementary and secondary schools. Analysis will include the elementary and secondary school as institutions, innovation in organization and curriculum, administration of instructional and noninstructional personnel, and community relationships.

564 Educational Finance. Spring term. Credit three hours. T 3:35–6. G. Winter.
Introduction to problems of resource procurement and allocation in education. Attention will be focused on existing and alternative strategies of fiscal support for schools and new management techniques for allocating such resources.

565 Supervision and Educational Professions Development. Spring term. Credit three hours. T Th 2:30–4. H. Wardeberg.
Role and function of preservice and inservice programs in educational professions development. Includes analysis of teaching as a means of facilitating improved instruction in educational institutions.

568 (560) Public School Law. Spring term. Credit three hours. W 10:10–12:05. L. B. Hixon.
Review and analysis of federal and state legislation, court decision, opinion, and regulations which affect New York State public schools.

569 Personnel Development. Fall term. Credit three hours. For graduate students only. Th 9:05–11. J. R. Egner.
Focus is on development of a conceptual framework for understanding roles and functions of educational personnel responsible for personnel development, and on developing skills in identifying and analyzing personnel problems, planning alternative strategies to cope with problems, and evaluating selected courses of action.

573 Structure of Knowledge. Spring term. Credit three hours. M W 11:15. D. B. Gowin.
The concept of the structure of a discipline and the development of a systematic method for the analysis of knowledge claims are the main concerns of this seminar. These concerns are related to the nature of teaching, curriculum theory and research, educational policy, and nontraditional forms of educational practice.

[574 History of American Education. Fall term. Credit three hours. For graduate students and seniors. M 3:35–6. F. H. Stutz. Not offered in 1974–75.
An examination of the role of education in influencing the development of the American society.]

575 Educational Policy Issues. Fall term. Credit three hours. For seniors and graduate students. W 2:30–4:30. F. H. Stutz.
Topic for 1974: Alternative forms of education.

576 Economics and Educational Policy. Fall term. Credit three hours. T 3:35–6. J. Klees.
An examination of the present state of the research on selected topics in the economics of education. The emphasis will be placed on the implications for educational policy-making.

578 Comparative Education. Fall term. Credit three hours. M 3:35–6. F. H. Stutz.
A comparative study of selected institutions, systems and issues, to view educational development in the context of historical, social, and economic trends.

580 The American College Student. Spring term. Credit three hours. T Th 10:10–12:05. K. M. Moore.
Study of the student in the American college with emphasis on developmental theories and current research.

581 Student Personnel Administration. Fall term. Credit three hours. Prerequisite: permission of the instructor. T Th 1:25–2:45. K. M. Moore.
Analysis of the objectives, functions, and organization of student personnel services in higher education. Emphasis on behavioral science theories supporting student personnel administration.

583 Counseling. Fall term. Credit three hours. Prerequisite: 555 or equivalent (may be taken concurrently) and consent of instructor. M W 1:25–2:45. D. E. Hedlund.
Examination of the process of counseling and of alternative delivery models for counseling

services. Introduction to theories of counseling. Basic training in interpersonal helping processes.

584 Group Counseling. Spring term. Credit three hours. Consent of instructor. M W 1:25–2:45. D. E. Hedlund.
Techniques and principles of counseling with groups. Critical examination of current literature on group counseling. Student projects to design and test group approaches.

586 Organization of Higher Education. Spring term. Credit three hours. T Th 1:25–2:45. K. M. Moore.
Designed to provide a broad perspective on the higher education enterprise. Students will gain an understanding of how higher education is organized institutionally, state-wide, and nationally, they will investigate critical roles and relationships which impinge on growth and development, and they will examine current research and commentary.

587 Practicum for Counselors in the Use of Tests. Credit two hours. Spring term. Prerequisite: Ed. 555 or equivalent. Th 3:35–6. H. G. Andrus.
The use of standardized tests in the psychological appraisal of individuals. Emphasis will be placed on the case study approach to the interpretation of tests and the application of these diagnostic tools to the counseling process.

589 Affective Education. Spring term. Credit three hours. Th 2:30–4:30. D. E. Hedlund.
Utilizes an experience-based, participatory design to develop basic interpersonal and small group skills and to introduce a conceptual framework for the design, application, and evaluation of humanistic education techniques and courses. Appropriate for counselors, teachers, and administrators concerned with the development of psychological education.

594 College Teaching. Fall term. Credit three hours. M W 1:25–3:20. J. D. Novak.
Designed for those who plan to teach in colleges and universities. Concepts of teaching, organization of subject matter, motivation, learning, testing, grading, and similar topics are treated.

599 Methods of Educational Inquiry. Fall term. Credit three hours. Prerequisite: one course in statistics or 452 elected concurrently. T Th 2:30–4. J. Millman and Staff.
For graduate students in their first year of residence. Emphasis will be placed upon describing and analyzing such procedures as forming concepts, making observations and measurements, building models and theories, providing explanations, and making predictions.

600 Internship in Education. Fall and spring terms. Credit two to six hours as arranged. Staff.
Opportunity for practical experience in educational administration, agricultural and occupational education, personnel administration, supervision, and other types of professional service in education.

602 Field Laboratory in Student Personnel Administration. Fall and spring terms. Credit and hours to be arranged. Permission of instructor required. Staff.
Directed field project in student personnel administration.

606 Seminar in Science Education. Fall and spring terms. Credit one hour. S-U grades exclusively. M 4:25–6. J. D. Novak and staff.
For all graduate students who major or minor in this program.

613 Seminar in Educational Psychology. Fall term. Credit three hours. Permission of instructor required before first meeting. T 4:25–6:15. M. D. Glock.
Theoretical issues in the teaching of reading.

616 Seminar in Educational Research. Fall term. Credit three hours. Prerequisite: 453 and 599 or permission of the instructor. Time to be arranged. J. Millman.
Topic to be announced.

617 Seminar in Learning and Memory. Fall term. Credit three hours. Prerequisite: Psychology 306 or equivalent. Hours to be arranged. G. W. McConkie.
A study of current issues in the learning, retention, and transfer of verbal information.

618 Seminar in Educational Psychology and Curriculum Development. Spring term. Credit three hours. Permission of the instructor required. Hours to be arranged. R. E. Ripple.
Selected aspects of the relationship between curriculum and psychology of education.

626 Seminar in Extension and Continuing Education. Fall and spring terms. Credit one hour optional. Time to be arranged. Staff.
Provides opportunity for majors and minors in extension and continuing education and community service education and staff jointly to analyze and reflect on current professional issues.

627 Behavioral Change in International Rural Modernization. Spring term. Credit two hours. Th 1:25–3:20. J. P. Leagans.
Analysis of concepts and strategies for repatterning human behavior at both the macro and micro levels. Changes in human behavior are viewed as a dependent variable in the rural development process.

628 Problems and Issues in Continuing Education. Spring term. Credit three hours.

Permission of the instructor. M 2:30–4:30. Staff.
A major area of concern to extension education will be selected for intensive study by participating students and faculty. For graduate students in extension education and other fields with special relevance to the seminar topic.

630 Seminar in Agricultural Education. Spring term. Credit one hour. S-U grades exclusively. Th 2:30–4:25. Staff.
Recommended for Master's degree candidates who have had teaching experience and doctoral candidates with majors and minors in agricultural education. The seminar will be primarily centered in current problems and research in the field.

645 Seminar in Curriculum Theory and Research. Spring term. Credit three hours. S-U grades optional. Prerequisite: 545, 446, or permission of the instructor. Time to be arranged. G. J. Posner.
Theoretical issues in curriculum and appropriate areas for curriculum research are discussed. The student is expected to identify and articulate a curriculum-related problem appropriate for research.

663 Seminar in Sociology of Education. Fall term. Credit three hours. Consent of instructor required. T 9:05–11:15. E. J. Haller.
Consideration of selected topics in sociology of education relevant to organization and policy issues.

668 Seminar in Educational Administration. Spring term. Credit three hours. Consent of the instructor. Th 9:05–11:15. J. R. Egner.
Consideration of planning and policy issues in public schools and higher education. Attention is directed to educational planning methodology, evaluation of strategies for long range planning, and the uses of futurist techniques in educational planning.

669 Studies in Educational Administration. Fall and spring terms. Credit three hours. Consent of instructor required. Th 3:35–6. J. R. Egner, E. J. Haller, L. B. Hixon.
Intended to provide beginning graduate students in educational administration with a critical introduction to research topics in this field and to inform them of the potential of those topics for thesis research.

670 Seminar in the College and University. Spring term. Credit three hours. S-U grades optional. T Th 12:20–2:20. D. B. Gowin.
Conditions of disciplined inquiry in higher education.

671 Seminar in Analysis of Educational Concepts. Spring term. Credit three hours. Admission by consent. W 10:10–12. K. A. Strike.
Topic for 1975 to be announced.

673 Seminar on John Dewey. Fall term. Credit three hours. Consent of the instructor required. T 12:20–2:20. D. B. Gowin.
Primary aim is a critical understanding and appraisal of Dewey's philosophy, especially as it centers upon education.

674 Seminar in History of Education. Spring term. Credit three hours. Admission by consent. M 3:35–6. F. H. Stutz.
Topic for 1975 to be announced.

681 Seminar in Student Personnel Administration. Fall and spring terms. S-U grades optional. Credit and hour to be arranged. Prerequisite: permission of the instructor. D. E. Hedlund and K. M. Moore.
Topic varies.

699 Conceptual Problems in Educational Inquiry. Fall term. Credit three hours. Time to be arranged. K. A. Strike.
An examination of such concepts as causation, operationalism, validity, reliability, hypothetical construct, generalization, explanation, probability, and hypothetico-deductive method.

Entomology

General Entomology

212 Insect Biology. Fall term. Credit three hours. Prerequisite: Biological Sciences 101–102 or concurrent registration or their equivalent. Lectures, W F 11:15. Laboratory, M T W Th or F 2–4:25. G. C. Eickwort and assistants.
Designed to introduce the science of entomology by focusing on the basic principles of the systematics, morphology, physiology, behavior, and ecology of insects. The laboratory in early fall includes field trips to collect insects and study them in their natural environment. A small collection stressing ecological categories is required.

518 Techniques of Biological Literature. Fall term. Credit two hours. Offered in alternate years. Lectures, T Th 9:05. J. G. Franclemont.
History of the development of entomological literature and critical study of the biologists' works of reference. Practice in the use of indices and bibliographies and practice in the preparation of the latter.

Insect Taxonomy, Morphology, and Acarology

322 Insect Morphology. Fall term. Credit four hours. Prerequisites: 212 and permission of instructor. Lectures, M F 10:10. Laboratories, M F 1:25–4:25. G. C. Eickwort.
An introduction to the external and internal anatomy of insects, with emphasis on the comparative and functional aspects. The laboratory is devoted largely to dissection.

331 Introductory Insect Taxonomy. Spring term. Credit three hours. Prerequisite: 212. Lecture, Th 10:10. Laboratories, T Th 2–4:25. J. G. Franclemont.
An introduction to the systematics and distribution of insects. Laboratory practice in the identification of orders, families, and representative genera of insects; methods of collection and preparation of insect specimens. Field trips are taken in the late spring.

[521 Acarology. Fall term. Credit four hours. Prerequisite: 212 and permission of instructor. Lectures, M F 10:10. Laboratories, M F 1:25–4:25. G. C. Eickwort. Not offered 1974–75.
An introduction to the taxonomy, morphology, and bionomics of mites and ticks, with emphasis on taxa of economic importance. A collection will be required.]

[531 Taxonomy of the Smaller Orders of Insects. Fall term. Credit three hours. Offered in alternate years. Prerequisite: 331. Discussion, F 10:10. Laboratories, F 2–4:25 and one other by arrangement. W. L. Brown. Not offered in 1974–75.
Discussions of the classification, evolution, and bionomics of the orders and families of insects, exclusive of the larger orders of Holometabola. Laboratory studies on the literature and on the characters and classification of representative genera and species. Continuation of taxonomy of Holometabola is in courses 532, 533, and 534.]

532 Taxonomy of the Immature Stages of Holometabola. Fall term. Credit three hours. Offered in alternate years. Prerequisite: 531 or permission of the instructor. Lecture, W 10:10. Laboratories, W F 2–4:25. J. G. Franclemont.
Lectures on structure and habits of insect larvae. Laboratory studies of the literature, comparative morphology, and identification of the immature stages of the Holometabola.

533 Taxonomy of the Coleoptera and Lepidoptera. Spring term. Credit three hours. Offered in alternate years. Prerequisite: 331. Lecture, W 10:10. Laboratories, W F 2–4:25. J. G. Franclemont.
Laboratory studies on the literature and on the character and classification of representative genera and species of these orders.

[534 Taxonomy of the Diptera and Hymenoptera. Spring term. Credit three hours. Offered in alternate years. Prerequisite: 331. Lecture, W 10:10. Laboratories, W F 2–4:25, and one other by arrangement. W. L. Brown. Not offered 1974–75.
Laboratory studies on the literature and on the characters and classification of representative genera and species of these orders.]

Economic Entomology

241 Applied Entomology. Spring term. Credit three hours. Prerequisite: Biological Sciences 101–102 or equivalent. Lectures T Th 10:10. Laboratory T 2–4:25. E. M. Raffensperger.
Life histories of insects of direct importance to agricultural production will be reviewed as well as procedures of detection, identification, and methods of control.

340 Insect Pest Management. Spring term. Credit three hours. Prerequisite: 212, 400, or Biological Sciences 361. Two lectures and one laboratory. Time to be arranged. R. G. Helgesen.
A lecture and laboratory introduction to principles and techniques of insect pest management as these relate to the diverse problems in contemporary economic entomology.

341 Arthropod Pests of World Importance. Credit two hours. Term and time to be arranged. Prerequisite: 340. Entomology faculty.
A survey of the life histories and socioeconomic importance of arthropod pests of world significance.

342 Special Topics in Economic Entomology. Credit two hours. Term and time to be arranged. Prerequisite: 340. To be taught every two or three years. Entomology faculty and invited lecturers.
Deals with topics such as legislation and regulation of pesticides, pesticide application techniques, etc.

Apiculture

260 Introductory Beekeeping. Spring term. Credit two hours. T Th 11:15. R. A. Morse.
Intended to afford a general knowledge of the fundamentals of beekeeping including the life history, instincts, and general behavior of honey bees. Special attention is given to the biology of the honey bee. Some lectures are

devoted to pollination of agricultural crops and the production of honey and beeswax.

262 Biology of the Honey Bee. Fall term. Credit one hour. Limited to 10 students. Registration by permission only. Fifteen laboratories by arrangement in September and October only. R. A. Morse.
A laboratory and field course in which the classical experiments on the vision, chemical senses, and language of the honey bee, as described by von Frisch, are repeated. Laboratories include demonstration of the sex attractant, swarm orientation, the natural nest, and a study of wasp, bumble bee, and other social insect nests.

Medical Entomology and Insect Pathology

452 Medical Entomology. Fall term. Credit three hours. Prerequisite: 212 and Biological Sciences 351 or their equivalents. Two lectures and one laboratory. Time to be arranged. E. W. Cupp.
Discussion of insects and other arthropods of public health and veterinary importance, the manner in which these arthropods transmit pathogens, and principles and practice of vector control.

453 Insect Pathology. Spring term. Credit three hours. Prerequisite: a course in entomology, a course in microbiology, and permission of instructor. Lectures M W 9:05. Laboratory F 9:05–12:05. J. P. Kramer.
A survey of the diseases of insects caused by viruses, bacteria, fungi, and protozoans with special emphasis on pathogenesis, pathologies, and epidemiology. The role of microbial disease in natural and applied insect control is considered.

Environmental Entomology

400 Insect Ecology. Fall term. Credit three hours. Prerequisite: 212 and Biological Science 361 or their equivalents. Lectures, W F 10:10. Laboratories, W F 1:25–4:25. R. B. Root.
Familiarity with the principles of ecology is assumed; emphasis will be placed on integrating these ideas through detailed analysis of entire life systems. Adaptive strategies of insects, functional role of arthropods in terrestrial ecosystems, methods of sampling, natural history of major arthropod guilds, contrast between natural and managed systems, and principles of functional analysis will be discussed.

471 Bionomics of Fresh-Water Invertebrates. Spring term. Credit three hours. Prerequisite: 212. Biological Sciences 361 is recommended. Lecture: F 10:10. Laboratories: Both F 2–4:25 and S 8–10:25. C. O. Berg.
A field and laboratory study of the bionomics of fresh-water invertebrates. Includes: characteristics of fresh-water habitats, identification of insects and other invertebrates, life cycles, and consideration of the ecological relationships among organisms in various aquatic biotopes.

577 Biological Control. Fall term. Credit three hours. Prerequisite: 212, Biological Sciences 361 and consent of instructor. Lectures, T Th 9:05. Laboratory, 2–4:25. M. J. Tauber.
Theory and method of biological control of arthropod pests and weeds.

595 Environmental Biology. Fall and spring terms. Credit one or two hours. Prerequisite: permission to register. Time to be arranged. D. Pimentel.
Environmental pollution and how pollutants affect man and the life system as a whole. Emphasis will also be given to the application of ecological principles and systems management as a means of restoring the quality of our environment.

660 Insect Ecology Field Course. Spring term. Credit two hours. Prerequisite: courses in ecology, entomology, and taxonomy. Consent of instructor is required. W 7:30 p.m. The class will be away from campus during the spring recess and the following week. R. B. Root.
A field course stressing the methods for study of insect populations and communities. The class will engage in a coordinated set of projects at the Archbold Field Station and Everglades National Park in Florida.

[662 Insect Behavior Seminar. Spring term. Credit one hour. Prerequisites: 212 and Biological Sciences 320 or equivalent. T 3:35. G. C. Eickwort and M. J. Tauber. Not offered in 1974–75.]

Insect Physiology, Biochemistry, and Insecticidal Chemistry

583 Insect Physiology Lectures. Spring term. Credit three hours. Open to seniors in entomology and graduate students. No prerequisite but courses in biochemistry, physics, and animal physiology are recommended. M W F 9:05. R. L. Patton.
An introductory course in the physiology of insects. Primarily for graduate students in entomology, or physiology majors.

584 Insect Physiology Laboratory. Spring term. Credit two hours. Laboratories, M W 2–4:25. R. L. Patton.
A laboratory course to accompany Insect Physiology Lectures. Should be taken in conjunction with Insect Physiology Lectures.

587 Insect Biochemistry. Fall term. Credit two hours. Consent of instructor is required. Time to be arranged. R. G. Young.

590 Insect Toxicology and Insecticidal Chemistry. Spring term. Credit four hours. Offered in alternate years. Prerequisites: general chemistry and organic chemistry. Undergraduate students by permission. Lectures, M W F 8. Laboratory, day to be arranged, 1:25–4:25. C. F. Wilkinson.
The chemistry of insecticides and their metabolism and mode of action in insects and mammals.

Research or Special Topics

Fall and spring terms. Credit to be arranged. Prerequisite: permission to register. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade.

408 Undergraduate Research. Entomology faculty.

418 Special Topics for Undergraduates. Entomology faculty.

507 Special Topics for Graduate Students. Entomology faculty.

508 Graduate Research. Entomology faculty.

509 Teaching Entomology. Entomology faculty. Credit is given for teaching or extension training.

Seminar

Jugatae. Fall and spring terms. M 4–5.
A seminar is conducted by Jugatae, the entomology club of Cornell University, to discuss topics of interest to its members and guests.

Floriculture and Ornamental Horticulture

General Courses

General Horticulture (Vegetable Crops 103).

Introduction to Landscape Design (Landscape Architecture 102).

100 Introductory Floriculture and Ornamental Horticulture. Fall term. Credit three hours. S-U grades optional for students not specializing in floriculture. Lecture: T Th 10:10. Laboratory, T 2–4:25. J. W. Boodley.
An introduction to the opportunities and scope of the field and the Department of Floriculture and Ornamental Horticulture at Cornell. A rationale for information that will be obtained in subsequent courses taken in the Department and the College to develop student awareness of the vital impact ornamental horticulture in its broadest sense has on everyday life. A required field trip to visit various commercial enterprises is made and costs approximately $15 plus room and meals.

105 Principles of Flower Arrangement. Fall or spring term. Credit two hours. Enrollment limited to twenty-four students for each laboratory section. Fall term. Lecture, Th 9:05. Laboratory, T W or Th 2–4:25. R. T. Fox. Spring term. Lecture-laboratory T W or Th 1:25–4:25. C. C. Fischer.
A study of the care and handling of flowers, the factors affecting keeping quality, and the design principles involved in the use of flowers and related decorative materials.

401–402 Physiology of Horticultural Plants. Fall and spring terms. Prerequisite: Biological Sciences 242 or 340 or permission of the instructor. Fall term: credit three hours; lecture, T Th 8. Laboratory, Th 1:25–4:25. H. B. Tukey, Jr. Spring term: credit four hours; lecture, M W F 8. Laboratory, M 2–4:25. P. L. Steponkus.
401, fall term. Application of physiology to germination of seeds, rooting of cuttings, manipulation of bulbs, and propagation of plants by budding and grafting, stressing basic mechanisms concerning initiation and development of roots and shoots. 402, spring term. A study of the physiology of growth and development of horticultural plants in response to their environment.

Plant Materials

210 Taxonomy of Cultivated Plants. Fall term. Credit four hours. Intended primarily for departmental majors. Prerequisite: Biological Sciences 105–106 or its equivalent. Lecture, M W 10:10. Laboratory, M W 1:25–4:25. J. W. Ingram, Jr.
A study of the kinds of cultivated ferns and seed plants and their classification into families and genera. Emphasis is placed on methods of identification, and preparation and use of the analytical keys, the distinguishing characteristics of the families concerned, and their importance in ornamental horticulture.

213 Woody-Plant Materials. Spring term. Credit four hours. Prerequisite: 210 or permission to register. Lectures, T Th 9:05. Laboratory, T and W or F 2–4:25. R. G. Mower.
A study of the trees, shrubs, and vines used in landscape planting. Emphasis is placed on their identification and values for use as landscape material. The class visits Rochester parks and gardens. Cost: $5 plus one meal.

312 Herbaceous Plant Materials. Fall term. Credit three hours. Prerequisite: course 210 or permission to register. Lecture, T Th 10:10. Laboratory, T 2–4:25. R. G. Mower.
A study of the ornamental herbaceous plants

used in landscape and garden plantings. Emphasis is placed on the identification, use, and culture of bulbs, annuals, and perennials.

313 Woody-Plant Materials. Advanced Course. Fall term. Credit two hours. Limit thirty students. Prerequisite: 213. F 1:25–4:25. R. G. Mower.
The important groups of landscape materials and the literature of the subject. A knowledge of the ordinary woody plants for landscape use in the Northeast is presumed. Emphasis is on lesser-known northern plants and upon plant groups basic in landscape design in other regions of the United States. Opportunities for practice in the determination of unknowns and in the use of the literature are provided. A trip is taken to Washington, D.C., and vicinity. Cost $15 plus room and meals.

Nursery Management

314 Turfgrass Management. Spring term. Credit two hours. Prerequisite: Agronomy 200 or permission to register. Lecture, Th 11:15. Laboratory, Th 2–4:25. J. Kaufmann.
The principles, practices, and materials for the construction and maintenance of lawn, sports, and utility turfgrass areas.

317 Nursery Crop Production and Maintenance. Fall term. Credit four hours. Prerequisite: 401. Lectures, M W F 9. Laboratory, M 2–4:25. G. L. Good.
The problems of commercial propagation and growing of nursery plants to marketable stage. Digging, storage, and packaging of nursery stock are included. Consideration is given to the planting and culture of landscape plants. Some aspects of garden center management are stressed. Field problems and observational trips are included in laboratory work. Field trips cost $15 plus room and meals.

318 Advanced Turfgrass Management. Fall term. Credit two hours. Prerequisite: 314 or the equivalent. Lecture, M 10:10. Laboratory, M 2–4:25. J. Kaufmann.
A continuation of course 314, with emphasis on the application of basic principles to problems of such large-scale operations as landscape maintenance and the execution and maintenance of golf courses, athletic fields, industrial grounds, and nursery sod production. A weekend inspection trip is taken to experimental test plots and special turf areas. Cost $10 plus room and meals.

Commercial Floriculture

325 Flower-Store Management. Fall term. Credit three hours. Prerequisite: 105 and permission to register. Lectures and two hours to be arranged. Laboratory, F 2–4:25. R. T. Fox.
Lectures devoted to flower-shop management, business methods, merchandising, and marketing of floricultural commodities. Laboratories to include the application of subject matter and the principles of commercial floral arrangement and design. Required field trips made to flower shows and to wholesale and retail florist establishments. Cost: $15 plus room and meals.

[424 Florist Crop Production. Spring term. Credit four hours. Prerequisite: 401–402 (may be taken concurrently) or permission of the instructor. Offered in alternate years. Lectures, M W F 9:05. Laboratory, M 2–4:25. J. G. Seeley. Not offered in 1974–75.
The commercial production of florist crops. Emphasis is on culture of plants as influenced by greenhouse environment. Field trips are made to commercial greenhouses. Cost $15 plus room and meals.]

425 Greenhouse Production Management. Spring term. Credit three hours. Offered in alternate years. Prerequisite: an elementary course in horticulture or equivalent. Lectures, M W 9:05. Laboratory, W 2–4:25. R. W. Langhans.
Intended to provide the latest information relative to efficient operation and administration of a commercial greenhouse range outside the sphere of actual production methods for specific crops. Consideration is given to the industry and centers of production and competition, location of the greenhouse range, types of structures, heating and ventilation, plant containers, soils and fertilizers, photoperiod control, and harvesting and postharvest handling of floriculture crops. Field trips will be taken. Cost $15 plus room and meals.

Department Seminars

450 Special Topics in Floriculture and Ornamental Horticulture. Fall and spring terms. Hours and credit to be arranged. Written permission of staff member is required to register. Primarily for upperclass and graduate students. R. G. Mower.
Topical subjects in plant materials. Independent and group study of important groups of plant materials and of situations that affect their successful use in planting programs. The topics will be announced each year in the supplementary announcement.

550 Special Problems in Floriculture and Ornamental Horticulture. Fall or spring term. Credit one or more hours. S-U grades optional. Prerequisite: adequate training for the work. Undergraduates must attach to their preregistration material written permission from the staff member who will supervise the work and assign the grade. J. W. Boodley and staff.
Special work on problems under investigation by the department or of special interest to the student, provided adequate facilities are available. Students must satisfy the staff member

under whom the work is to be taken that their preparation warrants their choice of problems.

600 Seminar. Fall and spring terms. S-U grades only. For departmental staff and graduate students. Th 12:20.

109–110 Drawing for Landscape Students.

111 Freehand Drawing.

211 Freehand Drawing and Illustration.

214 Water Color Illustration.

316 Advanced Drawing.

417 Scientific Illustration.

Freehand Drawing and Illustration

109–110 Drawing for Landscape Students. Credit three hours a term. Credit may not be received for both course 109 and 111. S-U grades optional for graduate students only. Fall term is prerequisite to spring term. The course is restricted to department majors. Others admitted with the permission of the instructor on a space available basis. Preregistration is permitted for department majors only. Fall term, M W 1:25–4:25. Spring term, T Th 1:25–4:25. A. Elliot and R. J. Lambert.
109, fall term, emphasizes the development of a graphic language and an approach to freehand perspective sketching. 110, spring term, includes practice in perspective construction from plans and elevations, rendering techniques, and basic design principles. Sketchbook assignments, to be done outside class, are given throughout the years.

111 Freehand Drawing. Fall or spring term. Credit three hours. Credit may not be received for both 109 and 111. Prerequisite: permission of instructor to register. S-U grades optional for graduate students only. Fall term schedule: M W F 9:05 to 11:15; lecture M 9:05. Spring term schedule: six hours total must be scheduled in either two- or three-hour units between 9:05 and 12:05 M T W Th F or T 2–4:25. These hours must include lecture T or W 10:10. A. Elliot and R. J. Lambert.
The objective is to develop accuracy of observation and skill in delineation. Practice is given in outdoor sketching and in the drawing of still-life set-ups, interior scenes, and human figures. The principles of freehand perspective are taught and applied. The course is designed to aid those who plan to work in nature study, biological sciences, and human ecology. Sketchbook assignments to be done outside class are given throughout the year.

211 Freehand Drawing and Illustration. Fall term. Credit two hours. S-U grades optional for graduate students only. Prerequisite: Drawing 111 or the equivalent. Six hours of time are to be spent in the drawing room, preferably in two-hour units. These hours should be scheduled between 9:05 and 12:05 M T W Th F. R. J. Lambert.
From object drawing at the beginning of the course, the student progresses to the organization of a complete illustration. The subject matter is derived largely from quick, on-the-spot sketches. Composition, perspective relationships, and ways of rendering are all considered. The work is planned primarily to help students who expect to use their sketching ability in landscape work, interior decorating, or the illustrating of their own papers, bulletins, and books.

214 Water Color Illustration. Spring term. Credit two hours. Prerequisite: 111 or the equivalent. S-U grades optional for graduate students only. Six hours of practice must be scheduled, preferably in two hour units, between 9:05 and 12:05 M T W Th F. R. J. Lambert.
The student learns to mix colors, lay washes, and plan the values of his composition before he tries illustration in color.

316 Advanced Drawing. Fall or spring term. Credit two hours. S-U grades optional. Three hours of practice required for each hour of credit. Prerequisite: 110, 312, or the equivalent. Time to be arranged. A. Elliot and R. J. Lambert. For students who wish to attain proficiency in some particular type of illustration or technique.

417 Scientific Illustration. Fall term. Credit two hours. S-U grades optional. Prerequisite: 211 or permission of the instructor. Six hours of practice to be scheduled, preferably in two-hour units, between 9:05 and 12:05 M T W Th. A. Elliot.
A survey of methods of illustration. Training in techniques of accurate representation in media suitable for reproduction processes, including pen and ink, scratchboard, wash, and mixed media.

102 Introduction to Landscape Architecture.

231 Landscape Architectural Design I.

232 Landscape Architectural Design II.

242 Residential Landscape Design.

332 Landscape Architectural Design III.

333 Landscape Architectural Design IV.

434 Landscape Architectural Design V.

435 Landscape Architectural Design VI.

437–438 Landscape Architectural Theory.

341–342 Site Construction.

451 Professional Practice.

555 Special Problems in Landscape Architecture.

Food Science

100 Introductory Food Science. Fall term. Credit three hours. M W F 10:10. N. N. Potter.
A survey course intended to expose the student to the broad field of food science and technology, its scope, principles, and practices. Lectures will deal with the constituent properties of foods, methods of food preservation, the major food groups, including their handling and processing, and current problems such as chemical additives and world feeding needs. Throughout the course the interrelationships between sanitation, processing nutrition, and food quality will be stressed.

150 Food Facts and Fads. (S-U optional). Spring term. Credit two hours. Evening lectures, M 7:30. Discussion periods (one hour) to be arranged. W. F. Shipe, staff, and invited speakers.
A series of public lectures dealing with current topics relating to foods. Attempts will be made to dispel misconceptions about food properties and the factors affecting them. Lectures are open to students and the public. Students taking the course for credit will participate in weekly discussions dealing with the lecture material and assigned readings.

210 Food Analysis. Spring term. Credit three hours. Prerequisite: Chemistry 104 or 108. Lecture, W F 12:20. Laboratory, F 1:25–4:25. J. W. Sherbon and assistants.
Designed to acquaint the student with a variety of chemical and bacteriological tests used by food analysts. Emphasis is placed on good analytical techniques.

[211 Milk and Frozen Desserts. Fall term. Credit two hours. Given in alternate years. Lecture W 12:20. Laboratory W 1:25. Stocking 119. W. K. Jordan and R. R. Zall. Not offered in 1974–75.
Deals with the principles and practices of processing fluid milk products and frozen desserts. The chemical, microbiological and technological aspects of processing these dairy products will be considered. Field trips to processing plants will supplement the lectures and laboratory work.]

300 Physical Chemistry of Foods I. Fall term. Credit three hours. Lecture M W F 11:15. J. W. Sherbon.
The application of physicochemical principles to the understanding of complex behavior of food systems and biological materials. Study of the principles involved in the behavior of emulsions and colloidal suspensions. The properties of solutions, reaction rates, electrolytic dissociations, hydrogen ion concentration, oxidation reduction potential, photochemistry, and introduction to energy relationships.

301 Nutritional Aspects of Raw and Processed Foods. Spring term. Credit three hours. M W F 9:05. Prerequisite: Human Nutrition and Food 115 recommended. D. C. Graham.
Those principles that relate processing procedures to the nutritional value of foods are dealt with.

302 Introduction to Food Engineering. Fall term. Credit four hours. Prerequisites: 100 and a course in physics. Lectures, M W F 10:10. Laboratory, M 1:25–4:25. W. K. Jordan.
Engineering aspects of dairy and food plant operations.

303 Introduction to Food Packaging. Spring term. Credit three hours. T Th 10:10–12:05. T. W. Downes.
A discussion of the techniques employed in package design. Topics will include product requirements, material selection, package form, marketing consideration, basic economics and legal considerations.

304 Sanitary Principles, Toxicology, and Public Health. Fall term. Credit three hours. Offered in alternate years. Prerequisite: Food Science 100. Lectures, T Th 12:20. Laboratory, T 1:25–4:25. R. R. Zall.
Biological and chemical control of food contamination and processing. U.S. Public Health Service, USDA, FDA, and other requirements for production, protection, and processing of foods. Quality assurance in foods.

400 Undergraduate Research in Food Science. Fall or spring term. Credit two hours. Except for students enrolled in the Honors Program, credit will be limited to four hours. Students must attach to their preregistration material written permission from the staff member who will supervise the work and assign the grade. Staff.

[401 (402) Concepts of Product Development. Spring term. Credit two hours. S-U optional. Offered in alternate years. Prerequisite: F.S. 100 or equivalent. M W 10:10. Not offered 1974–75. L. F. Hood.
A discussion of the sequence of events involved in the development and marketing of food products. Topics will include packaging and labeling, food additive and ingredient regulations, taste panels, market testing, market research and patents.]

[402 (402A) Product Development Laboratory. Spring term. Credit two hours. S-U optional. Offered in alternate years. W F 1:25–4:25. L. F. Hood and assistants. Not offered 1974–75.

A laboratory to be taken concurrently with F.S. 401. Emphasis will be on gaining practical experience in the development of new foods.]

[403 International Food Science and Development. Fall term. Credit three hours. Offered in alternate years. M W 1:25–4:25. F. V. Kosikowski. Not offered 1974–75.
An exploration of the elements and characteristics of international food science and a study of the development, processing, and marketing of staple and exotic foods throughout the world. Attention will be given to expanding protein resources for man in critical areas. International aspects of pollution and public health related to food are considered. Special attention is given to the organization, operations, relationships, and contributions of UN technical agencies, FAO, UNICEF, WHO, and governmental and nongovernmental organizations in the field.]

[404 Food Processing I—Drying, Freezing, Heat Preservation. Spring term. Credit three hours. Offered in alternate years. Lectures, T Th 11:15. Laboratory T 1:25–4:25. N. N. Potter. Not offered 1974–75.
Deals with the principles and practices of drying, freezing, canning, and other heat treatments applied to foods. Current processing methods will be considered as related to the chemistry, microbiology, and technology of the ingredients and final products.]

405 Food Processing II—Concentrating, Separating, Mixing. Spring term. Credit three hours. Offered in alternate years. Lectures, T Th 10:10. Laboratory, T 1:25–4:25. W. K. Jordan and R. R. Zall.
Deals with the principles and practices of evaporation, reverse osmosis, homogenization, size reduction and other unit operations important to the food industry.

[406 Food Processing III—Fermentations. Fall term. Credit four hours. Offered in alternate years. Prerequisite: a beginning course in biology, microbiology, or biochemistry is recommended. Lectures (discussions and demonstrations), T Th 11:15–4:25. F. V. Kosikowski and R. A. Ledford. Not offered 1974–75.
Principles and processes leading to important foods such as fermented milks, yogurt, cheese, wines, and beers. Consideration is also given to other fermentations resulting in foods from plant, animal and enzyme sources. Practices designed to acquaint students with fermentation and enology principles and with the physical and sensory qualities of the above foods are carried out by demonstration and through field trips.]

407 Food Processing IV—Fats and Oils. Fall term. Credit three hours. Offered in alternate years. Open to upperclassmen and graduate students. Lecture demonstrations, W F 9:05. Laboratory practice, F 1:25–4:25. J. E. Kinsella.
The sources, composition, and properties of edible fats and oils are discussed. All classes of lipids are considered, and their effects on food quality and storage stability are described. Factors affecting the chemical and physical stability of food fats are enumerated. The chemical technology of emulsions, shortenings, edible oils, margarine, and butter is described.

409 (410A) Food Chemistry. Spring term. Credit two hours. Prerequisites: Organic Chemistry or Biochemistry. Concurrent registration in 410 recommended. Lecture, T Th 9:05. W. F. Shipe.
Deals with the effect of chemical composition on the properties of foods. Special attention will be given to the factors affecting variation in composition and the consequent changes in flavor, color, and texture.

410 (410B) Sensory and Objective Evaluations of Foods. Spring term. Credit two hours. Prerequisite: Statistics. Concurrent registration in 409 recommended. Lecture, Th 12:20. Laboratory, W or Th 2–4:25. W. F. Shipe.
Deals with sensory techniques used to evaluate the flavor, color, and texture of foods and the effect of these properties on consumer acceptance. Objective methods for measuring these qualities will be discussed and demonstrated.

[411 Food Mycology. Fall term. Credit three hours. Given in alternate years. Prerequisite: Microbiology 290A, 290B or equivalent. Microbiology 394 is recommended. M W F 10:10. D. C. Graham. Not offered 1974–75.
The purpose is to acquaint students with those groups of fungi that are important both from the standpoint of their beneficial as well as their harmful effects in food production, preservation, and spoilage. Further, the intent is to give the student some appreciation of the use of fungi as food.]

415 Principles of Food Packaging. Fall term. Credit three hours. M W F 9:05. T. W. Downes.
Intended primarily for seniors and graduate students in food science and related fields. The basic properties of some packaging materials and systems will be discussed and these principles will be utilized to describe packaging systems for specific applications (e.g., meats, dairy products, fruits and vegetables, fats and oils, etc.). Engineering considerations will not be stressed.

501 Protein and Food Enzymes. Fall term. Credit three hours. Offered in alternate years. Open to graduate students. M W F 12:20.
The first part of the course deals with the general properties of proteins: structure, preparation, and reactions. The second part deals with proteins as part of food systems, occurrence and composition, associations and structures, and reactions to processing. The use

and application of enzymes in the food industry will be discussed.

502 Food Lipids. Fall term. Credit three hours. Offered in alternate years. Open to graduate students. T Th 8. J. E. Kinsella. Covers the disposition of lipid materials in foods and the manner in which lipids influence the chemical and physical attributes of various foods. The effects of production techniques, storage, heating, refrigeration, and enzymes on food lipids are described and the chemical mechanisms involved in oxidation are elucidated. The importance of lipids in the formation of food flavors is discussed.

[503 Food Carbohydrates. Spring term. Credit two hours. Offered in alternate years. Open to qualified seniors and graduate students. Prerequisite: Biological Science 431 or equivalent. T Th 10:10. L. F. Hood. Not offered 1974–75.
A consideration of the chemistry of carbohydrates in foods including sugars, starches, pectins, gums, and cellulose. Emphasis will be placed on their origin in raw materials and the subsequent changes occurring during processing and storage.]

504 Chemistry of Dairy Products. Fall term. Credit two hours. Offered in alternate years. Prerequisites: qualitative and quantitative analysis and organic chemistry. Hours by arrangement.
A study of milk constituents and physical properties. Deals with milk enzymes, lactose, milk fat, milk proteins, and minor constituents.

505 Physical Chemistry of Foods II. Fall term. Credit three hours. Lecture, T Th 10:10–12:05. Offered in alternate years. J. W. Sherbon. The physical chemical principles of important food systems with special emphasis on colloids and emulsions. Reaction kinetics, thermodynamics, and molecular interactions will also be considered.

506 Instrumental Methods. Spring term. Credit five hours. Prerequisite: permission of the instructor. Lecture, M W F 8. Laboratory, M or T 1:25–4:55. J. W. Sherbon.
Deals with instrumental methods widely used in research and industry. The major emphasis is on chromatography, spectroscopy, electrophoresis, ultracentrifugation, thermal analysis, and the use of computers. The stress will be on the practical use of the material presented.

[507 High-Protein Food Technology. Fall term. Credit two hours. Offered in alternate years. Designed for graduate student majors in International Food Development but open to other qualified students. Recommended: Food Science 403 or equivalent. W 10:10–12:05. Other hours by arrangement. F. V. Kosikowski. Not offered 1974–75.
The needs, types, processing techniques, nutritional qualities, and economics of high-protein foods for an expanding world population are examined in discussions and through individual study. Basic protein foods from cereals, pulses, oil seeds, milk, and marine life will be considered along with single-cell protein foods from whey, cellulose, leaves, and petroleum.]

[508 Food Color and Food Pigments. Fall term. Credit one hour. Lecture, F 12:20. Offered in alternate years. Prerequisite, Organic Chemistry. J. P. Van Buren. Not offered 1974–75.
An introduction to theories of color perception and color spaces will be followed by a survey of chemical and physical properties of the major food pigments and their stability during processing and storage. Color and pigments of selected commodities will be examined in detail.]

509 Rheology. Spring term. Credit one hour. Lecture, F 12:20. Offered in alternate years. M. C. Bourne.
The fundamental concepts of rheology as applied to foods with emphasis on objective methods for measuring physical properties of foods. The principles and practice involved in measuring texture of solid foods, viscosity of liquid foods, and consistency of semisolid foods, instrumentation, and correlations between objective and sensory methods of texture measurements. Examples of rheological problems in each major food group are discussed.

510 Chemical Toxicology. Fall term. Credit one hour. Lecture, F 11:15. Offered in alternate years. G. S. Stoewsand.
An introduction to the concepts of toxicology as related to foods: physiologically active compounds in natural and processed foods; antinutritive substances; intentional food additives; potential contaminants. Safety evaluation and regulation of foods. Assigned writing or brief student lecture will widen knowledge of current research.

[511 Viniculture and Enology. Fall term. Credit two hours. Offered in alternate years. Prerequisite: FS406 or equivalent. M 10:10–12:15. F. V. Kosikowski. Not offered 1974–75.
A graduate student course in wine culture, production and taste appreciation. The historical and geographical evolution of wine-making, wine classification and quality and technical advances will be covered through lectures, discussions, and demonstrations.]

512 Cereal Science and Technology. Fall term. Credit three hours. P. A. Buck. T Th 10:10–12:05.
The cereals are mankind's most useful plants, and have been used for centuries, yet new commercial products arise yearly. The science and technology of cereal products will be

studied as one of the most developed applications of the basic sciences. Students will evaluate methods and operations with which trained food technologists should be familiar, and will perform some of these. Some entirely new techniques, experiments, and apparatus will be introduced. Field trips required.

513 Analysis of Toxicants. Spring term. Credit one hour. M 12:20. Offered in alternate years. Prerequisites: Organic Chemistry and Quantitative Analysis. D. J. Lisk.
The classification, movement, reactions and effects of toxicants such as pesticides and toxic metals in the environment are summarized. Extraction, isolation, and chromatographic separation of toxicants are discussed. Analysis by specific detector gas chromatography, spectrometric, and electrochemical methods are emphasized.

599 Preparation for Food Science Teaching. Fall and spring terms. Open to qualified Food Science graduate students not already serving as teaching assistants. Department head and staff.
Designed to give graduate students some experience in teaching and in the preparation of courses. Participants will assist professor in regular Food Science courses, including some actual teaching experience, and will be required to attend a number of orientation lectures on teaching techniques.

600 Seminar. Fall and spring terms. Credit one hour. S-U for graduate only. Required of all food science graduate students.

Advanced Microbiology 390

394–395 Food Microbiology (Microbiology 394A and 394B).

Meat and Meat Products (Animal Science 290).

Science and Technology of Meat, Fish and Eggs (Animal Science 490).

Postharvest Handling and Marketing of Vegetables (Vegetable Crops 312).

Marketing (Agricultural Economics 240).

International Agriculture

600 Seminar: International Agricultural Development. Fall and spring terms. No credit. Third and fourth Wednesdays of each month, 4–5. Staff in International Agriculture.
Primarily for graduate students interested in an integrated view of problems related to international agricultural development. Undergraduates with a specialization in international agriculture are encouraged to attend without registering. The seminar will focus on developing an understanding of the nature and interrelatedness to agricultural development of the social sciences, plant and animal sciences, foods and nutrition, and natural resources.

601 Philippine Agricultural Development: Policy and Administration. Spring term. Credit two hours. Th 3:35. F. H. Golay and G. Levine.
Major aspects of Philippine agricultural development will be considered from economic, social, and technological points of view.

602 Special Studies of Problems of Agriculture in the Tropics. Spring term. Credit three hours. Enrollment is limited to graduate students and upperclassmen and must be approved by one of the instructors. Prerequisite: one or more courses from IA listing or permission of instructors. Lecture and discussion: two hours a week, Th 2:30–4:25. Two week field-study trip during January to Puerto Rico and/or other Latin American countries. The Office of International Agriculture should be consulted regarding financial arrangements. Staff in International Agriculture.
Oriented to provide advanced undergraduate and graduate students, with a career interest in tropical agriculture, an opportunity to extend their academic studies in the tropical agriculture sciences to a field situation, and to promote interdisciplinary exchange among students. The study trip will be in collaboration with the University of Puerto Rico and institutions in other countries visited. Discussions and assignments during spring semester deal with problems in agriculture and livestock production in the context of social and economic conditions.

Economics of Agricultural Geography (Agricultural Economics 150).

Regional Agricultural Development (Agricultural Economics 452).

Economics of Agricultural Development (Agricultural Economics 464).

Food, Population, and Employment (Agricultural Economics 660).

Seminar on Latin American Agricultural Policy (Agricultural Economics 665).

Seminar on Agricultural Policy (Agricultural Economics 751).

Seminar in Agriculture and Economic Planning Models (Agricultural Economics 769).

Identification, Appraisal, and Geography of Soils (Agronomy 301).

Tropical Meteorology (Agronomy 331).

Geography and Appraisal of Soils of the Tropics (Agronomy 401).

Soil Clay Mineralogy (Agronomy 405).

Tropical Agriculture (Agronomy 422).

Management Systems for Tropical Soils (Agronomy 480).

Grasslands and Grassland Research (Agronomy 614).

Livestock Production in Warm Climates (Animal Science 400).

Forages of the Tropics for Livestock Production (Animal Science 403).

Intercultural Communication (Communication Arts 501).

Communication in the Developing Nations (Communication Arts 524).

Comparative Mass Media (Communication Arts 526).

Designing Extension and Continuing Education Programs (Education 524).

Educational Communication (Education 525).

Teaching Agricultural and Occupational Education (Education 532).

Behavioral Change in International Rural Modernization (Education 627).

International Food Science and Development (Food Science 403).

High Protein Food Technology (Food Science 507).

International Natural Resources (Natural Resources 511).

International Nutrition Problems, Policy, and Programs.
See the *Announcement of the Graduate School of Nutrition.*

Plant Diseases in Tropical Agricultural Development (Plant Pathology 655).

Economic Fruits of the World (Pomology 301).

Subsistence Agriculture in Transition (Rural Sociology 157).

Rural Development and Cultural Change (Rural Sociology 355).

Social Change in Community and Regions (Rural Sociology 606).

Macrosociological Description of a Single Country (Rural Sociology 715).

Macrostructural Research Methods (Rural Sociology 716).

Applications of Sociology to Development Programs (Rural Sociology 751).

Peasants, Water, and Development (Rural Sociology 754).

Special Topics in Plant Science Extension (Vegetable Crops 429).

Research Methods in Applied Plant Science (Vegetable Crops 501).

Landscape Architecture

102 Introduction to Landscape Architecture. Fall and spring terms. Credit three hours. M W F 9:05. R. L. Dwelle.
Introductory lecture about the design of the exterior environment; the scope and principles of landscape architecture are graphically presented with the intention of serving as a basis for each individual's participation in influencing the physical design organization and aesthetic quality of his or her community. Open to nonmajors as well as first-year Landscape Architecture majors.

231 Landscape Architectural Design I—Basic Landscape Design. Fall term. Credit four hours. Prerequisite: one course in freehand drawing. Lecture: M 8. Studios: M W F 10:10 to 12:35. P. Tresch.
The basic principles of site-design and problem-solving techniques are the focus. An approach to design, design element relationships, site analysis, spatial composition, vehicular and pedestrian circulation, earth form, design vocabulary, and graphics are dealt with. This is the first of a total of six design studio courses requiring three academic years to complete. Each of the studio courses which follow will focus on a particular area of landscape architectural design emphasis.

232 Landscape Architectural Design II—Project Planning. Spring term. Credit four hours. Prerequisite: 231. Lecture: M 8. Studios: M W F 10:10 to 12:35. P. Tresch.
This second course in the sequence concentrates on the development of design and graphic skills applied to site planning projects of increasingly larger scale and complexity.

242 Residential Landscape Design. Spring term. Credit three hours. Prerequisite: 231. One hour lecture and 5 hours of study time. Schedule to be arranged. R. J. Scannell.
Deals with the following: siting of a house;

indoor-outdoor relationships; grading and layout of walks, drives, entrance and service areas, terraces and decks, pools, and other site development areas; fencing, walls, lighting, paving, and other site construction materials; and outdoor furnishings and planting design for residential properties.

332 Landscape Architectural Design III—Recreation Design. Fall term. Credit five hours. Prerequisite: 232. Lecture: M 1. Studios: M W F 2–5:20. M. I. Adleman.
Concentrates on the design of recreational facilities ranging in scale from regional and metropolitan parks to urban parks and playgrounds as well as private and commercial recreational facilities.

333 Landscape Architectural Design IV—The Urban Landscape. Spring term. Credit five hours. Prerequisite: 232. Lecture: M 1. Studios: M W F 2–5:20. P. Tresch.
Design analysis and development of the urban landscape including urban form alternatives and perceptual form giving components. Urban open space, the streetscape, street furniture, and site design within various land-use concentrations will be explored.

434 Landscape Architectural Design V—Land Analysis and Environmental Planning. Fall term. Credit five hours. Prerequisite: 333. Lecture: W 1. Studios: M W F 2–5:20. P. Tresch.
Large scale land analysis and planning utilizing methods of working with environmental determinants and restraints, land suitability studies, visual and scenic analysis, evaluation of landscape type and character, and design criteria for land use and open space planning in rural and semirural areas.

435 Landscape Architectural Design VI—Housing and Land Development. Spring term. Credit five hours. Prerequisite: 434. Lecture: W 1. Studios: M W F 2–5:20. M. I. Adleman.
Land design at the scale of entire communities and new towns, including site selection, land acquisition, legislation, program development, site planning, staging, cost analysis, and financing.

437–438 Landscape Architectural Theory. Fall and spring terms. One or both courses may be taken. Credit two hours per term. Prerequisite: 232. Lecture: W 7:30–9:30 p.m. M. I. Adleman.
A reading and seminar course exploring current as well as past literature on design theory relating to landscape architecture.

341–342 Site Construction. Fall and spring terms. Credit four hours a term. Prerequisite: Agricultural Engineering 222. Fall term is prerequisite to spring term. Fall term lectures T Th 10:10. Studios: T Th 2–4:30. Spring term lectures M W 8. Studios: T Th 8–10:30. M. I. Adleman.
The technical aspects and procedures necessary in the development of construction working drawings for landscape architectural design projects. The course deals with grading and earthwork, layout and calculation of vehicular and pedestrian circulation, site construction materials, basic structural principles, construction detailing, site utilities and lighting, and cost analysis.

451 Professional Practice. Fall term. Credit two hours. Lecture: T 1. Studio: T 2–4:25. M. I. Adleman.
An extensive coverage of methods used in the professional practice of landscape architecture together with current office procedure.

555 Special Problems in Landscape Architecture. Fall or spring term. Credit one or more hours. Prerequisite: 232 and permission of the staff member who will supervise the work. Design faculty.
Special work on Landscape Architectural problems of interest to the student.

Microbiology

290 (290A) General Microbiology Lectures. Fall or spring term. Credit three hours. Prerequisites: Biological Sciences 101–102 and Chemistry 104 or 108. It is recommended that 291 be taken concurrently. Lectures, M W F 11:15. Fall term. H. W. Seeley; spring term, P. J. Van Demark.
A study of the basic principles and relationships in the field of microbiology, with fundamentals necessary to further work in the subject. The spring term will provide special emphasis on the application of microbiology in home economics and agriculture.

291 (290B) General Microbiology Laboratory. Fall or spring term. Credit two hours. M W 2–4:25; T Th 8–11 or 2–4:25. Fall term, H. W. Seeley; spring term, P. J. VanDemark.
A study of the basic principles and techniques of laboratory practice in microbiology and fundamentals necessary to further work in the subject.

390 Advanced General Microbiology Lectures. Fall term. Credit three hours. Prerequisites: 290, 291, and organic chemistry. Lectures, M W F 11:15. E. A. Delwiche, N. C. Dondero, H. B. Naylor, P. J. VanDemark.
A consideration of the morphological, taxonomic, cultural, and physiological characteristics of important groups of heterotrophic microorganisms. May be taken independently of 391.

391 Advanced General Microbiology Laboratory. Fall term. Credit two hours. Prerequi-

site: concurrent or previous enrollment in 390; Enrollment limited. M W 2–4:30. E. A. Delwiche, N. C. Dondero, H. B. Naylor, P. J. VanDemark.
Intended as a laboratory complement to 390. The isolation, characterization, and study of cultures of microorganisms representative of important groups of heterotrophs.

393 Applied and Industrial Microbiology. Fall term. Credit three hours. Prerequisite: 290. Lectures, T Th 10:10–11:25. E. A. Delwiche, N. C. Dondero and P. J. VanDemark.
A survey of the microbiology of industrial fermentations, water, and waste decomposition.

394 (394A) Food Microbiology Lectures. Spring term. Credit two hours. Prerequisite: 290, 291. Lectures, M W 12:20. H. B. Naylor.
The major families of microorganisms of importance in foods are studied systematically with emphasis on the roles played by these organisms in food preservation, food fermentations, and public health.

395 (394B) Food Microbiology Laboratory. Spring term. Credit two hours. Prerequisites: 290, 291. Graduate students must have permission of the instructor. Laboratory M W 2–4:25. H. B. Naylor.
Work includes studies of the physiological characteristics of representative food microorganisms, practice in the use of general and special methods for microbiological testing and control of food products, and practice in the isolation and characterization of organisms of importance in foods.

412 Aquatic Microbiology. Spring term. Credit three hours. Offered in alternate years. Prerequisite: introductory bacteriology (Microbiology 290, or Soil Science 306). T Th 2:30–3:45. N. C. Dondero.
A consideration of the relation of microorganisms, especially the bacteria, to aquatic environments, both natural and artificial. The microbiology of waste waters will be included. Attention will be given to fundamental biological concepts and to applied aspects of the occurrence and activities of microorganisms in water.

490 Microbial Physiology Lecture. Spring term. Credit three hours. Prerequisites: Microbiology 290 and Bio. Sci. 431 (or permission of instructor). Lectures T Th 9:05. T. L. Weaver.
The concern is with the physiological functions of microorganisms. Particular consideration is given to the dynamics of growth, the nutrition and the energy metabolism of developing cultures, and the interactions of the physical and chemical environments with the growth process. The composition and structure of microbial cells, the metabolism of cellular constituents, and various microbial processes such as transport, enzyme regulation, and sporulation will be discussed.

491 Microbial Physiology Laboratory. Spring term. Credit three hours. Prerequisites: Microbiology 291, concurrent or previous enrollment in 490, and permission of the instructor. Enrollment limited. T Th 10:10–12:40. T. L. Weaver.
The laboratory component of 490. Selected exercises to illustrate the fundamental points discussed in lecture. The student will be exposed to techniques and instruments useful for studying microbial physiology.

492 Microbial Ecology. Spring term. Also listed as Agronomy 410. Credit three hours. Offered in alternate years. Prerequisite: elementary course in some facet of microbiology. M W F 10:10. M. Alexander.
An introduction to the basic principles of microbial ecology. Attention is given to behavior, activity, and interrelationships of bacteria, fungi, algae, and protozoa in natural ecosystems.

496 Selected Topics in Microbial Metabolism. Spring term. Credit two hours. S-U grades optional. Prerequisites: beginning courses in general microbiology, biochemistry, and organic chemistry. Primarily for upperclassmen and graduate students. Lectures, M W 11:15. E. A. Delwiche.
Selected topics pertaining to the energy metabolism, oxidative and fermentative abilities, and biosynthetic capacities of microorganisms. Where possible and appropriate the subject matter deals with the various microbial forms in a comparative sense.

499 Research in Microbiology. Fall or spring term. Credit and hours to be arranged. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. This course cannot be used to fulfill the specialization requirement.

691 Graduate Seminar in Microbiology. Fall and spring terms. Credit one hour each term. Required of all graduate students majoring in microbiology. Time to be arranged. Staff.

699 Microbiology Seminar. Fall and spring terms. Noncredit. Required of graduate students majoring in microbiology and open to all who are interested. Time to be arranged. Staff.

Food Mycology (Food Science 411).

[Soil Microbiology (Agronomy 306).]

[Soil Microbiology (Agronomy 307).]

Advanced Soil Microbiology (Agronomy 506).

Microbial Genetics, Lectures (Biological Science 485).

Microbial Genetics, Laboratory (Biological Science 486).

Basic Immunology Lecture (Veterinary Medicine 340).

Pathogenic Microbiology (Veterinary Medicine 341).

[Advanced Immunology Lecture (Veterinary Medicine 941).]

[Advanced Immunology Laboratory (Veterinary Medicine 942).]

Advanced Work in Bacteriology, Virology, or Immunology, (Veterinary Medicine 944).

Animal Virology and Tissue Culture Methods (Veterinary Medicine 945).

Natural Resources

101 Introduction to Natural Resources. Fall term. Credit one hour. S-U grades. Freshman and transfer students in the Department of Natural Resources or permission of instructor. M 2–4:30. H. B. Brumsted and staff.
An introduction to the field of natural resources, particularly as reflected by the subject areas and interests within the Department. Several field trips during class periods and Saturdays.

110 Ecological Basis for Conservation. Spring term. Credit two hours. Lecture, T Th 10:10 or 12:20. R. J. McNeil.
Ecological principles as applied to man's use of his environment, especially its living components. Survival strategies of animals and the application of these concepts to man. Ecological succession, carrying capacity, limiting factors, population dynamics, animal behavior, disease, effects of pesticides on living organisms and systems, other contaminants, noise, heat, nuclear radiation, extinct and endangered species, management of plants and animals and the land, pressures on natural systems caused by technology and increasing human populations, and what to do about it.

111 Ecological Basis Discussions. Spring term. Credit one hour. Corequisite: 110. Times and places to be arranged. Staff.
Treatment of lecture material from 110 in greater depth and with various emphasis depending on the background and interests of the instructors and students.

201 Environmental Conservation. Fall term. Credit two hours. T Th 10:10 or 12:20. R. J. McNeil.
Man, natural resources, and environment. Man's use and misuse of the natural components of his environment. Current resource use problems such as air and water pollution, radiation, garbage and waste, and the population explosion. A brief survey of natural resources emphasizes land, water, soil, plants and animals, minerals and energy. Resource-use policies are related to social problems, and an attempt is made to introduce the concept of a conservation ethic.

202 Environmental Conservation Discussions. Fall term. Credit one hour. Corequisite: 201. Times to be arranged. Staff.
Treatment of lecture material from 201 in greater depth and with various emphasis depending on the background and interests of the instructors and students.

415 Public Relations in Natural Resources Management. Spring term. Credit three hours. Prerequisite: at least junior standing. Other than Natural Resources majors must have consent of instructor. Limited to thirty-five. Lecture, M W 9:05. Laboratory, Th 1:25–3:30. A. Dickson.
Methods of attaining and maintaining good public relations in the natural resource management professions through the use of effective communications, the media, and understanding the publics involved.

430 Population Dynamics of Fish and Wildlife. Spring term. Credit two hours. Prerequisite: senior or graduate standing in the Department of Natural Resources, or consent of instructor. T Th 10:10. Staff.
Characteristics of fish and game populations and the analysis of data for purposes of projection. An examination of the processes that control the abundance of organisms. This course includes a consideration of mortality, reproductive potential, density-dependent and

density-independent regulation, predator-prey and parasite-host relationships. Examples are taken mainly from areas of fishery and wildlife science. Emphasis will be placed on the practical application of course material.

500 Thesis Research and Professional Projects. Fall and spring terms. Credit and hours arranged. S-U grades only. Staff.
Limited to graduate students working on thesis research or professional Master's projects.

610 Conservation Seminar. Fall and spring terms. Noncredit. Th 4–5:30. Staff.
All graduate students in the Field of Conservation are expected to participate.

Resource Analysis and Planning

203 Natural Resource Inventories. Spring term. Credit three hours. Lecture, M T 12:20. Laboratory, M T W 2. E. E. Hardy.
Procedures for inventorying resources, the methods used, and theories of inventory development in relation to present needs. Examination of the processes used in generating currently used inventories, application of methods to improve existing inventories, and experience in developing inventories will be undertaken. Laboratory section offers opportunity to generate inventories of resource information for selected area. Field trips.

421 Seminar in Remote Sensing of Natural Resources. Fall term. Credit two hours. T 7–9. E. E. Hardy.
Characteristics of various remote sensors will be described and their sensor capability identified. Current and potential applications for sensing natural resources will be considered and simulated, and actual problems of benefit analysis undertaken. Guest lecturers.

[510 Perspectives on Conservation. Fall term. Credit two hours. Graduate standing or permission of instructor. Th 1:25–3:30. B. T. Wilkins. Not offered in 1974–75.
A seminar based upon extensive readings of articles highlighting varying philosophical approaches to the conservation of natural resources. Views espoused by developmentalists, preservationists, naturalists, economists, welfare economists, and urban planners will be considered.]

511 International Natural Resources. Fall term. Credit two hours. Upperclassmen and graduate students only. Hours to be arranged. L. S. Hamilton and R. J. McNeil.
A seminar devoted to exploring international programs of nature conservancy; extinct and endangered species; floral and faunal protection in various countries; national park systems; protection vs. management; the relevance of United States experience; role of nature conservancy in resource development of emerging nations. Foreign students especially are invited.

602 Seminar in Natural Resource Analysis for Ecologically Based Planning. Spring term. Credit two hours. W 2:30. L. S. Hamilton.
Multidisciplinary graduate student-faculty-invited specialists seminar. Theme varies from year to year but usually involves a case study of a specific area of land and water. The ecological basis for planning land and water use. Engineers, economists, sociologists, soil scientists, fish or wildlife biologists, foresters, ecologists, and planners especially invited. Field work involved.

604 Seminar on Selected Topics in Natural Resources Conservation. Spring term. Credit one hour. Time to be arranged. Staff.
Primarily for graduate students majoring or minoring in natural resources conservation.

498 Research in Resource Analysis and Planning. Either term. Permission of instructor. H. B. Brumsted, L. S. Hamilton, J. W. Kelley, R. J. McNeil, and B. T. Wilkins.

499 Research in Remote Sensing of Resources. Either term. Permission of instructor. E. E. Hardy.

Resources Economics (Agricultural Economics 450).

Ecological Aspects of Evaluating Environmental Quality (Agricultural Economics 350).

Analysis and Interpretation of Aerial Photographs (Engineering IIA 687).

Physical Environment Evaluation (Engineering IIA 685).

Outdoor Recreation

419 (420) Outdoor Recreation. Fall term. Credit two hours. Prerequisite: 201. Open to seniors and graduate students and to juniors with permission of the instructor. T Th 11:15. G. R. Reetz.
Factors involved in allocating natural resources for outdoor recreation are considered. Characteristics of public and private administration of recreation area are studied and trends in outdoor recreation explored.

420 (420A) Field Studies in Outdoor Recreation. Fall term. Credit one hour. Open to seniors and graduate students. Prerequisite: 419 or concurrent registration. W 2–4:25. G. R. Reetz.
A methodology course for students desiring experience with applied aspects of outdoor recreation data collection and analysis for research and planning.

620 Seminar in Outdoor Recreation Policies. Spring term. Credit two hours. Prerequisite: 420 or permission of instructor. Th 2–4. G. R. Reetz.
A review and discussion of current policy issues important in determining use of natural resources for recreation. Aspects relating to state and national areas including parklands, coastal regions, recreation areas, reservoirs and forests will be considered.

493 Research in Outdoor Recreation. Either term. Permission of instructor. B. T. Wilkins, G. R. Reetz.

Recreation Leadership (Rural Sociology 230).

Forestry

205 Maple Syrup Production. Spring term. Credit one hour. S-U grades only. Limited to fifteen students. Three preliminary seminars, followed by several half days of field work on appropriate selected days during the maple season. Students must have Tuesday afternoon and another weekday afternoon free after 12:00. First class meeting at 3:00 on first Tuesday of semester. R. R. Morrow and A. Fontana.
Students will work in most phases of the Arnot Forest maple operation and learn modern sap collecting techniques and quality control in making syrup. A 250-tap area is reserved for student installation of a tubing sap collection network.

302 Forest Ecology. Fall term. Credit three hours. Limited to forty students. Lectures, M W 10:10. Laboratory, M 1:25–4:25. L. S. Hamilton.
Understanding the wildland environment. Development of ability to identify and analyze what is present, what was present, what is likely to happen in various forest ecosystems. All laboratory sessions in the field. One required weekend trip to the Adirondacks or other major forest region.

303 Woodlot Management. Fall term. Credit three hours. Lecture, M W 11:15. Laboratory, W 1:25–4:25. S-U grades optional. (Three field laboratories will end at 5:30 because of travel time.) R. R. Morrow.
Designed to give the student the basic information necessary to permit sound woodland management decisions. Field trips to woodlots emphasize variations in value and potential as well as biological growth. Introduction to tree identification, log scaling, timber estimating, tree marking, and stand improvement work. Planting, management, harvesting, marketing, Christmas trees, maple syrup, and multiple use are discussed, as well as relationships of forestry to people and to the environment.

496 Research in Forestry. S-U credit. A. Dickson, L. S. Hamilton, R. R. Morrow and F. E. Winch.

Fishery Biology

440 Fishery Science. Fall term. Credit four hours. Prerequisite: Statistics and 1 year of calculus. Open to seniors majoring in fishery science and graduate students by permission of instructor. M W F 12:20. Laboratory, W 1:25–4:30. Staff.
Principles and theories involved in dynamics of fish populations. Methods of obtaining and evaluating statistics of growth, population size, mortality, yield and production, as well as investigational aspects of fishery biology are included. Laboratory will consist of field experience in obtaining and analyzing information necessary for estimating vital statistics of fish populations.

441 Fishery Resource Management. Spring term. Credit three hours. Prerequisite: 440 or permission of instructor. Lecture, T Th 11:15. Laboratory, W 1:25. A. W. Eipper.
Principles and problems in the management of freshwater and marine fishery resources, considered in relation to problems of human population and management of other natural resources. Multiple use concepts, allocation problems, and the economic, legal, and political ingredients in solving those problems. Characteristics of fishery resources and their exploitation. Policies and techniques in managing fish stocks through maintenance and improvement of habitat, fish population manipulation, and regulation of fishing.

442 Techniques in Fishery Science. Fall term. Credit two hours. For upperclassmen and graduate majors only. Limited to fifteen students. T Th 1:25–4:25. One or more week-end field trips will be scheduled. D. A. Webster.
Emphasis is placed on methods of collecting fish and related data when information on population dynamics are of paramount importance. Laboratories include field experience in use of various gear and instruments. Opportunities for additional experience in on-going college fishery research program will be provided.

443 Ecological Aspects of Water Resources Management. Fall term. Credit three hours. Limited to 30 students; seniors or graduate students only. T Th 9:05. W or F 1:25–4:25. R. T. Oglesby.
Basic structural and dynamic aspects of freshwater and estuarine ecosystems are reviewed. The nature and modes of action of stresses imposed by man on the systems and their significance to management decisions are then studied. A number of case histories are reviewed in depth and several field trips taken.

444 Aquaculture. Spring term. Credit three hours. Prerequisites: Biological Sciences 468 or permission of instructor. T Th 12:20. Laboratory Th 2:30–4:25. J. G. Nickum.

Introduction to the development, techniques, and uses of aquaculture. The historical development and current status of cultural practices for fishes and invertebrates throughout the world will be considered, with emphasis upon North American species of special importance both for outdoor recreation and for food production. Laboratory will consist of discussions, demonstrations, and field trips. One or more weekend (or vacation period) field trips will be scheduled.

601 Seminar or Selected Topics in Fishery Biology. Fall or spring term. Credit one hour. Time to be arranged. Staff.

494 Fishery Biology. A. W. Eipper, J. L. Forney, J. G. Nickum, R. T. Oglesby, C. L. Schofield, D. A. Webster, and W. D. Youngs.

Bionomics of Fresh-Water Invertebrates (Entomology 471).

Biology of Fishes (Biological Sciences).

Oceanography (Biological Sciences 461).

Ichthyology (Biological Sciences 470).

Marine Ecology (Biological Sciences 566).

Limnology (Biological Sciences 462).

Phycology (Biological Sciences 344).

Wildlife Science

304 Wildlife Ecology. Fall term. Credit two hours. T Th 10:10. A. N. Moen.
Consideration of the basic physical, physiological, interspecific, and intraspecific relationships of the organism and its environment.

410 Principles of Wildlife Management. Fall term. Credit three hours. Prerequisites: junior standing and one ecology course. M W F 9:05. Instructor to be appointed.
Fundamental characteristics and mechanisms of wildlife population and habitats. Includes ecological, social, and economic aspects of wildlife management.

411 Wildlife Management Methods. Spring term. Credit two hours. Prerequisite: 410. F 11:15, 1:25–4:30. J. W. Caslick.
Introduction to methods of management of wildlife and practical application of these techniques in the field. Intended for wildlife science majors.

412 Wildlife Management Laboratory. Fall term. Credit one hour. Prerequisite: 410 or concurrent registration. F 1:25–4:30. Several all day field trips. Instructor to be appointed.
Laboratory problems in wildlife management. Involves data collecting and analysis. Intended for wildlife science majors.

Mammalogy, Lectures (Biological Sciences 471). Fall term. Credit three hours. Prerequisite: 101–102; Lectures, T Th S 10:10. J. W. Hudson and M. E. Richmond.

Mammalogy, Laboratory (Biological Sciences 471). Fall term. Credit two hours. Prerequisite: concurrent enrollment in 471. Laboratory, T Th or W F 1:25–4:25. J. W. Hudson and M. E. Richmond.
Laboratory and field work on ecology, behavior, physiology, and the taxonomy of recent mammals, with emphasis on the North American fauna.

495 Research in Wildlife Science. Either term. Credit and time to be arranged. Permission from instructor. Staff.

504 Analytical Ecology. Spring term. Credit three hours. Prerequisite: permission of the instructor. T Th 9:05. Laboratories to be arranged. A. N. Moen.
Basic physical, chemical, physiological, and behavioral relationships between free-ranging animals and their environment are analyzed. The course consists of field and laboratory exercises with considerable class discussion.

603 Wildlife Science Seminar. Fall and spring terms. Credit one hour. Prerequisite: consent of instructor. W 3:35. Staff.
Discussion of individual research or current problems in wildlife science.

Ornithology (Biological Sciences 472).

Soils (Agronomy 200).

Plant Breeding and Biometry

Biometry courses are listed under Statistics and Biometry.

Plant Breeding

503 Methods of Plant Breeding. Fall term. Credit four hours. Primarily for graduate students, but open to qualified seniors who expect to engage in plant breeding. Prerequisite: Biological Sciences 101–102 and 281, and a course in at least one of the following: field crops, vegetable crops, floriculture, or pomology. Laboratory discussion T Th 1:25–4:15. R. P. Murphy and H. M. Munger.
Breeding systems for producing the possible crop variety forms are considered in detail. Laboratories include controlling pollination, producing heritable variation, and selection techniques with emphasis on disease resistance. There will be a Saturday field trip to the N.Y.

State Agricultural Experiment Station at Geneva, N.Y.

505 Physiological Genetics of Crop Plants. Spring term. Credit three hours. Prerequisites: Biological Sciences 281 and a course in biochemistry or plant physiology, or permission of the instructor. Discussion, T Th 8–10. D. H. Wallace.
Genetic, biochemical, and molecular mechanisms controlling plant variation in physiological phenomena such as photosynthesis, respiration, translocation, self-incompatibility, male sterility, seed dormancy, yield, and heterosis will be discussed. Biochemical and molecular mechanisms through which environmental factors like temperature, light, mineral elements, and water interact with genetics to alter phenotypic expressions of plant growth and development will also be covered. These genetic, physiological, biochemical, and environmental phenomena will be presented from data obtained through studies with higher plants. Emphasis will be upon physiological variation that can be exploited in plant breeding.

507 Research Orientation. Spring term. Credit two hours. Prerequisite: 503. Lectures, M W F 9:05 for the first ten weeks of the semester. C. O. Grogan and staff.
Designed to acquaint the student with the various facets of research in plant breeding. Particular attention will be given to concepts, philosophies relating to plant research, and oral and written communication procedures in research.

512 Experimental Methods. Spring term. Credit two hours. Offered in alternate years. Prerequisite: 511 or consent of the instructor. M W F 12:20. C. C. Lowe.
Use of statistical methods and application of experimental designs and plot techniques to problems in plant breeding and related agricultural research.

516 Advanced Topics in Plant Genetics and Breeding. Fall term. Credit three hours. S-U grades only. Graduate students only. Lectures, T Th 8–9:30. N. F. Jensen, V. E. Gracen, and R. L. Plaisted.
Designed for study in depth of advanced research and other topics of special relevance to plant genetics and breeding. Examples of research topics are: somatic hybridization, host-pathogen relationships, breeding for disease and insect resistance, parameters of yield, mutation or radiation breeding, uses of male sterility, world germ-plasm resources, mass selection, plant competition, and population dynamics.

550 Special Problems in Research and Teaching. Fall, spring, or summer. Credit one or more hours by arrangement with instructor. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. Members of the departmental staff.

622 Seminar. Fall and spring terms. Without credit. T 12:20. Members of the departmental staff and graduate students.

Plant Pathology

300 Introductory Plant Pathology (Lectures). Every fall and alternate spring terms. Credit two hours. Prerequisite: Biological Sciences 101–102, 103–104, or 105–106. Need not be taken concurrently with 301. T Th 11:15. C. W. Boothroyd.

301 Introductory Plant Pathology (Laboratory). Every fall and alternate spring terms. Credit two hours. Prerequisite: Biological Sciences 101–102, 103–104, or 105–106. Must be taken concurrently with 301. T W Th or F 2–4:25. Conferences to be arranged. C. W. Boothroyd.
An introduction to general plant pathology, including the nature, cause, and control of disease in plants. Fresh diseased specimens of plants: field and forage crops, fruits, ornamentals, trees and shrubs, and vegetables are studied in the laboratory.

302 Plant Disease Control. Spring term. Credit three hours. Prerequisite: 301 or equivalent. Lecture T Th 11:15. Laboratories and recitation Th 1:25–4:25. W. E. Fry.
For undergraduates who expect to engage in general or specialty farming, in pest control, or in agricultural extension or teaching. The course is designed to provide students with working experience with diseases. Recognition, identification, effect of environment, and epidemiology will be considered in relation to disease control. Rationale of procedures will be stressed in an integrated approach to disease control.

309 Introductory Mycology. Fall term. Credit four hours. Prerequisites: a year sequence of botany or its equivalent, and permission to register. Lecture, T Th 1:25–2:15. Laboratory, T Th 2:30–4:25 and one additional two-hour period to be arranged. R. P. Korf.
An introduction to fungi emphasizing biology and comparative morphology rather than taxonomy.

403 Pathology of Trees and Shrubs. Spring term. Credit three hours. Prerequisite: 301 or the equivalent. Lectures, W F 10:10. Laboratory, T or F 1:25–4:25. W. A. Sinclair.
For students desiring some specialized knowledge of diseases of trees and shrubs in preparation for nursery or landscape work, for careers

as park superintendents, arborists, or city foresters, or for other horticultural professions. Deals with the nature, recognition, diagnosis, and treatment of diseases of woody plants.

431 Undergraduate Research in Mycology or Plant Pathology. Fall or spring term or both. Credit three to five hours. S-U grades optional. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. Not less than three laboratories of three clock hours each week. Staff members. Designed to afford opportunity for selected undergraduates to test their inclinations and ability to do research work. The student is expected to prosecute with interest and enthusiasm, under informal direction of the professor, some problem or problems mutually agreed upon.

501 Advanced Plant Pathology. Fall term. Credit five hours. S-U grades optional for students with a minor in plant pathology. Prerequisite: a course in introductory plant pathology and permission to register. Lecture, T Th 11:15. Laboratory, T Th or W F 2–4:25. R. L. Millar.
Designed to acquaint the student with the basic principles and techniques of the science of phytopathology and to provide an adequate foundation for successful prosecution of research in this field.

502 Plant Disease Control and Epidemiology. Spring term. Credit two or three hours. Graduate students only. Prerequisite: 501 or its equivalent. Lecture M W 11:15. Laboratory to be arranged. W. E. Fry.
Designed to acquaint students with current and classical information and concepts concerning plant disease control. Epidemiology will be stressed, and will serve as a framework for control principles. Current control procedures will be analyzed and possible future innovations will be evaluated.

505 Plant Virology. Fall term. Credit three hours: in special cases permission may be obtained to enroll for lectures only (two hours credit). For graduate students with majors or minors in plant pathology; also open to graduate students interested in general virology. Prerequisite: 501 or permission to register. Lecture, T Th 10:10. Laboratory, F 1:25–4:25. M. Zaitlin.
Designed to provide advanced graduate students with basic information on plant viruses and on the diseases they cause.

506 Plant Nematology. Spring term. Credit three hours. Offered in alternate years. For graduate students with majors or minors in plant pathology and, in special cases, other students interested in nematology. Prerequisite: 501 or permission to register. Two lectures and one three-hour laboratory period each week. Hours to be arranged. W. F. Mai.
Anatomy, morphology, and taxonomy of plant parasitic forms and nonparasitic soil-inhibiting forms of nematodes are studied. Plant pathogenic forms also are considered from the standpoint of host-pathogen relationships, host ranges, life cycles, and the symptoms they cause. Principles and methods of control are discussed.

507 Bacterial Plant Pathogens. Spring term. Credit three hours. Given in alternate years. For graduate students with majors or minors in plant pathology; others by permission only. Prerequisite: 501 or permission to register. Lecture, T Th 10:10. Laboratory, W F 2–4:25. R. S. Dickey.
Designed to provide students with basic information on bacterial plant diseases and phytopathogenic bacteria. The laboratory will include some of the more important techniques used in the study of bacterial plant pathogens.

[508 Disease and Pathogen Physiology. Fall term. Credit three hours. Offered in alternate years. For graduate students with majors or minors in plant pathology; others by permission only. Prerequisite: 501, Biological Sciences 240 and 431, and permission to register. Lecture, W F 10:10. Laboratory, M 10:10–4:25. H. D. Van Etten. Not offered in 1974–75.
Designed to provide students with insight into the mechanisms of pathogenesis and altered metabolism of diseased plants.]

521 Experimental Methods in Plant Pathology. Fall term. Credit two hours. Offered in alternate years. For graduate students with a major or minor in plant pathology; others by permission only. M W 11:15. R. K. Horst.
Designed to provide students with basic information on the application of statistical procedures and experimental designs in plant pathological research.

531 Special Problems in Mycology or Plant Pathology. Fall or spring term, or both. Credit three or five hours each term. For graduate students only. Registration by permission. Three to five weekly laboratory periods of three hours each. Staff members.
For work in mycology, modern techniques and experimental approach are stressed in areas such as physiology, developmental morphology, genetic systems, or cytotaxonomy.
For work in plant pathology for minor thesis or problems, or for students wishing to develop familiarity with modern techniques in some phase of the science.
For work in plant nematology, research projects in five areas are stressed. These areas include host-parasite relations, virus transmission, nematode-fungus-bacterium relations, biology, behavior, population dynamics, reproduction

and growth, morphology, taxonomy, techniques, and control.

541 Philosophy of Plant Pathology. Fall term. Credit two hours. S-U grades only. Offered in alternate years. For Ph.D. students majoring in plant pathology. Prerequisite: 501, 579, and at least two other courses from 502, 505, 506, 507, and 508, or permission to register. Conferences, M W 8–10. D. F. Bateman.
A conference with advanced graduate students examining the concepts of plant pathology as they relate to the approach to basic and applied research problems, teaching, and extension.

556 Advanced Plant Nematology. Fall and spring terms. Credit three hours. For graduate students only. Prerequisite: Plant Pathology 506. Hours to be arranged. W. F. Mai.
Graduate students with special interest in plant nematology will conduct 4 research projects in areas such as taxonomy, morphology, permanent mounting, soil and plant sampling procedures, procedures for extracting nematodes from soil and plant tissues, culturing, host-parasite relationships between nematodes and microorganisms, and evaluation of control practices. This research is intended to broaden training in plant nematology and thus the projects selected will not duplicate thesis research.

[579 Advanced Mycology. Spring term. Credit four hours. Offered in alternate years. Prerequisite: 309 or its equivalent, a course in genetics, and permission to register. Lecture, M 10:10. Laboratory, M W 1:25–4:25 and one additional three-hour period to be arranged. R. P. Korf. Not offered in 1974–75.
A detailed study of the biology and taxonomy of the major groups of plant pathogenic fungi (rusts, smuts, Fungi Imperfecti, Peronosporales) with emphasis on mechanisms of variation in fungi. *Optional* field trips.]

[599 Taxonomy of Fungi. Fall term. Credit four hours. Offered in alternate years. Prerequisite: Plant Pathology 309 or its equivalent, a course in genetics, a course in plant or animal taxonomy, and permission of the instructor to register. Lecture, M W 10:10. Laboratory, M W 1:25–4:25. R. P. Korf. Not offered in 1974–75.
Emphasis is placed on the principles of taxonomy and nomenclature, critical evaluation of keys and monographs, and practice in identification. The Discomycetes, from which most examples are drawn, are treated in detail. *Required* field trips.]

645–656 Current Topics. Fall and spring terms. Credit to be arranged. For graduate students with special interests in the particular area. Prerequisite: permission to register. Time to be arranged.
Weekly discussions of current topics in special areas of plant pathology and mycology. Students will be required to do extensive reading of current literature and to present oral and written reports.

645 **Plant Virology**. S-U grades only. W. F. Rochow and M. Zaitlin.

646 **Plant Nematology**. S-U grades only. W. F. Mai.

647 **Bacterial Plant Pathogens**. S-U grades only. R. S. Dickey.

648 **Physiology of Plant Diseases**. S-U grades only. D. F. Bateman, R. L. Millar, and H. D. Van Etten.

649 **Mycology**. S-U grades only. R. P. Korf. Fall term: aphyllaphorales and tremellales. Spring term: lichens.

650 **Diseases of Vegetable Crops**. S-U grades only. J. W. Lorbeer and R. E. Wilkinson.

653 **Pathology of Trees and Shrubs**. S-U grades only. W. A. Sinclair.

654 **Diseases of Florist Crops**. S-U grades only. R. K. Horst.

655 **Plant Diseases in Tropical Agricultural Development**. S-U grades only. H. D. Thurston.

656 **Cytology of Plant Diseases**. S-U grades only. J. R. Aist and H. Israel.

661 Seminar. Fall and spring terms. Credit one hour. S-U grades only. Required of all majors in the Department. T 4:30–5:30. H. D. Thurston.

671 Plant Pathology Colloquium. Fall and spring terms. Credit one hour. S-U grades only. First and third Thursdays of each month. 8–10 p.m. Staff and graduate students.

Virology (Biological Sciences 498).

Special Studies in Tropical Plant Pathology (International Agricultural Development 602).

Pomology

General Horticulture (Vegetable Crops 103). Intended for students who want a general course in horticulture covering flowers, fruits, and vegetables.

101 Tree Fruits. Fall term. Credit three hours. Should be preceded or accompanied by an introductory course in biological science. Lecture, T Th 8. Laboratory, T or W 2–4:25. L. J. Edgerton.
A study of the general principles and practices of tree-fruit culture and their relation to the underlying sciences. Topics to be covered include propagation, varieties, orchard management, and growth and fruiting habits. Practical work is presented in grafting, pruning, site and soil selection, and planting.

102 Small Fruits. Fall term. Credit three hours. Should be preceded or accompanied by an introductory course in biological science. Lecture, M W 8. Laboratory, M 2–4:25 or 7:30–9:55 p.m. J. P. Tomkins.
A study of the general principles and practices in the culture of grapes, strawberries, brambles, and bush fruits; and their relation to the underlying sciences. Fruiting and growth habits are covered, with practical work in pruning, planting, and propagation. One all-day field trip will be taken.

201 Postharvest Physiology, Handling, and Storage of Fruits. Fall term. Credit three hours. Prerequisite: 101 or 102. Lecture, T Th 8. Laboratory, Th 2–4:25. Instructor to be appointed.
The chemistry and physiology of fruits as they affect quality and marketability are studied. Handling methods, maturity indices, and storage practices are considered. Practical work involves grading and inspection of fruits and storage of fruit in different ways. One Saturday field trip is required.

202 Advanced Laboratory Course. Spring term. Credit two hours. Th 1:25–4:25. L. J. Edgerton, and G. H. Oberly.
Designed to give more extended practice in the various orchard operations than can be given in 101. Special attention is given to problems of pruning, grafting, orchard soil selection and management, pollination, and spray practice. One or two field trips are taken.

[301 Economic Fruits of the World. Spring term. Credit three hours. Given in alternate years. Prerequisite: an introductory course in biological science, or permission to register. Lecture, M W 8. Laboratory, F 2–4:25. Instructor to be appointed. Not offered in 1974–75.
The more important subtropical and tropical fruit species such as citrus, banana, mango, coffee, and cacao are considered. Morphology, physiology, and adaptation to climate are stressed rather than details of culture. A broad view of world pomology is given.]

401 Advanced Pomology. Fall term. Credit three hours. Given in alternate years. Prerequisites: 101 or 102 and Introductory Plant Physiology or permission of the instructor. Lecture, M W F 8. L. L. Creasy.
A comprehensive study of the principles of Pomology in relation to other sciences and of the application of these sciences and current pomological research to the solution of present and future problems in commercial fruit growing.

501 Special Topics in Experimental Pomology. Spring term. Credit three hours. S-U grades optional. Offered in alternate years. Hours to be arranged. G. D. Blanpied; L. L. Creasy, D. C. Elfving, G. H. Oberly, and L. E. Powell.
Selected topics are considered with respect to the current literature and/or experimental techniques. Topics reflect the research interests of the several professors who participate.

502 Research. Fall, spring, or both terms. Credit two or more hours a term. S-U grades optional. Prerequisite: 401. Undergraduates must attach to their preregistration material written permission from the staff member who will supervise the work and assign the grade. Members of the departmental staff.

[504 Growth and Development of Woody Plants. Spring term. Credit two hours. Offered in alternate years. Primarily for graduate students; undergraduates admitted by prior approval of instructor. Prerequisite: introductory course in plant physiology. Lecture, T Th 9:05. L. E. Powell. Not offered in 1974–75.
An advanced course dealing with the growth and development of woody plants. Physiological responses are emphasized, but morphological and biochemical changes are also considered.]

600 Seminar. Fall and spring terms. One hour credit. Required of students taking 502 and graduate students in pomology. Th 4:30. Members of the departmental staff.

Poultry Science

(Refer to the joint listing of the Departments of Animal Science and Poultry Science under the heading Animal Science Program Area.)

Course	Old Number in Poultry Science	New Number in Animal Science
Introduction to Poultry Science	100	230
Poultry Hygiene and Disease	270	(Vet.) 255
Poultry Farm Management	280	330
Poultry Problems	390	390
Poultry Nutrition	415	415
Animal Cytogenetics	419	419
Comparative Physiology of Reproduction of Vertebrates	425	428
Reproductive Physiology of Vertebrates Laboratory	425A	429
Special Topics in Nutrition	511	512
Seminar in Poultry Biology	609	609
Field of Nutrition Seminar	619	619
Lipids	502	502
Vitamins and Minerals	504	504

Rural Sociology

100 General Sociology. Fall or spring term. Credit three hours. May not be taken by those who have credit for Sociology 101. T Th 10:10. One period discussion sections: fall, M or F 9:05–2:15, spring, M or F 9:05–2:15. Fall term, P. R. Eberts. Spring term, D. E. Moore and staff. A general introduction to the theory and methods of sociology. Major topics selected for discussion include socialization, deviancy and social control, stratification, ideology and social change. Discussions will focus on social issues and recent research.

[113 (220) Introductory Research Methods. Fall term. Credit three hours. S-U grades optional. M W F 1:25. J. D. Francis. Not offered in 1974–75.
The purpose is to initiate an interest in the strategies of both discovery and proof in social research. Problems of theory construction, concept formation and logical validity will be examined in the first part of the course. A second part of the course will be devoted to empirical research by survey technique. Problems of hypotheses formation, statistical inference and techniques of analysis will be discussed. A third part of the course will be concerned with model building as well as some criteria of legitimacy of evidence. As the course proceeds students will be encouraged to analyze their own data or work on the data set available for the course. It is expected that students will gain some familiarity in computer analysis and machine use.]

121 (210) Foundations for Decision Making and Social Action. Fall term. Credit three hours. S-U grades optional. Not open to freshmen. M W F 10:10. W. W. Reeder.
The purpose is to provide the basic information essential to an understanding of decision making, social action, and planned change. Designed for two categories of students: (1) students of various fields who wish to take one or two courses in sociology and who want to gain the kind of knowledge that relates directly to human relationships in their occupation and in their activities as organization members and citizens; (2) persons whose work or interests are likely to involve them in some phase of planned change—either as administrators, organization leaders, extension agents, teachers, or community development workers—and others for whom the role of change agent is an essential part of their job.

134 (230) Recreation Leadership. Spring term. Credit three hours. Lecture, W 1:25. Laboratory, W 7:30–9:10 p.m. Maximum 25 undergraduates; permission of instructor. B. M. Scott.
Background and theoretical framework for recreation leadership which provide the setting for recreation programming and leadership. Lectures, weekly laboratory in recreation leadership, and field assignments.

153 (365) National Development Policies and Locality Programs. Spring term. Credit three hours. W 2:30. F 1:25–3:20. G. J. Cummings.
A comparison of national policies and programs as implemented at local levels in the United States, Canada, and Latin America. The major focus is on policies and programs affecting the development potential of rural or nonmetropolitan areas. A variety of specific development projects are reviewed and evaluated.

157 Subsistence Agriculture in Transition. Fall term. Credit three hours. M W F 11:15. M. L. Barnett.
An analysis of selected types of peasant communities, drawn from differing ecological conditions (wet rice, rain-forest tropics, monsoon and subtropics and high altitude). Social structure, systems of farming and land tenure arrangements, motivational characteristics of subsistence farmers in the context of socio-economic change. Theoretical and policy aspects of modernization and traditional agriculture and programming for agricultural development.

162 (310) Rural Minorities in Comparative Perspective. Fall term. Credit three hours. Not open to freshmen. T Th 2:30–3:45. J. W. Converse.
The notion of internal colonialism will be examined as a framework for studying the situation of minority groups in various countries. Factors affecting the amount of social mobility and the degree of incorporation of marginal groups into the larger society will be examined. Action strategies for mobilizing groups toward higher levels of participation will be considered. Major emphasis will be directed toward rural Blacks, Chicanos, and Indians, but the situation of other ethnic minorities in the U.S. and the situations of minority groups in other countries will also be considered.

163 Strategies of Social Reform. Fall term. Credit three hours. M W F 12:20. A. D. Milnor.
A study of the structure of policy-making institutions and their relationship to societal subgroups. Within these relationships relevant techniques of social action, especially organization and mobilization, will be examined within selected problem areas. Special attention will be given to the potential sources of resistance and assessment of success and failure relative to various strategies. Comparisons will also be drawn as to the short- and long-term impacts of alternative strategies.

201 (200) Analysis of Selected Societal Field Problems. Spring term. Credit three hours.

T Th 10:10. Third session to be arranged. H. R. Capener.
Designed to follow course 100 through a close student-teacher working relationship. The course will enable students to explore in greater depth selected societal issues and problems. Students may choose among four topic areas offered. Since topics vary from year to year, consult the department office for the current listing. Sections offered in the past included international development, rural poverty, society of the future, and environmental sociology. Topics will be considered at the community, national and international levels.

314 (440) Introduction to Computer Uses in Data Analysis. Fall term. Credit three hours. S-U grades optional. Prerequisite: one course in statistics or permission of instructor. T Th 11:15. Laboratory to be arranged. D. E. Moore.
An introductory course in computing open to all students with interests in analyzing data. Topics will include: preparation and description of data; preparation and running of computer programs using the FORTRAN language; computer attributes and applications; library programs and associated facilities.

322 (405) Organization Dynamics. Spring term. Credit three hours. S-U grades optional. Prerequisite: 100 or 210 or permission of the instructor. Not open to freshmen or sophomores. M W 11:15–1:10. W. W. Reeder.
A study of the methods and techniques by which organization consultants, officers, group members, and administrators may increase the effectiveness of organizations. Five categories of organization problems are considered: (1) program problems, (2) leadership problems, (3) membership problems, (4) problems related to meetings, and (5) organizational and public relations problems. Organization theories are presented in relation to their uses in analysis, prediction, diagnosis, and in designing programs to bring about organizational changes. The first hour is a lecture-discussion period; the second hour is a group skills, group process, and group sensitivity laboratory.

323 (436) Social Movements and the Sociology of Confrontation. Spring term. Credit three hours. S-U grades optional. T Th 12:20–1:35. Enrollment limited to twenty-five. W. W. Bauder.
Designed to provide opportunity for maximum student participation. Students under faculty supervision will plan and organize the course which will follow a seminar format. The course content will be an interaction between available theories of collective behavior and selected comprehensive case studies. The theories of Blumer, Heberle, the Langs, Smelser, Toch, Turner, Young and others will be used to help understand selected cases from a wide range of social movements such as the Black Power movement, National Farms Organizations, and various student movements.

324 Social Organization and the Environment. Spring term. Credit three hours. Not open to freshmen or sophomores. M W F 9:05. E. W. Coward, Jr.
A discussion of principles involved in the interaction of man and his physical environment as viewed from an ecosystem perspective. Special emphasis will be given to the function of social organization in man-environment exchanges. Principles will be illustrated by referring to both pre-industrial and industrial societies. The course will provide a conceptual framework for understanding reoccurring environmental problems.

343 (443) Politics, Social Control, and Pluralism. Spring term. Credit three hours. S-U grades optional. Offered in alternate years. Open to upperclassmen and graduate students. Prerequisite: 100 or equivalent. T Th 12:20–1:35. P. R. Eberts.
Comparative analyses of substantive and methodological issues in social control processes within the political economies of primarily Western democracies, but with illustrative attention to Communist and developing societies. Pluralism and control will be viewed relative to productive, allocative, and staffing processes of society, as they affect various occupational categories, communities of different size, and institutions primarily responsible for maintaining social order.

344 (390) Social Stratification and Change. Fall term. Credit three hours. Prerequisite: R.S. 100 or equivalent, not open to freshmen or sophomores. M W F 1:25. D. E. Moore.
The focus will be on processes of social stratification as keys to understanding social change. Various theories of stratification will be reviewed before turning to an examination of current research. Particular attention will be given to the relationship between theory and research, especially the choice of indicators of stratification and change.

355 Rural Development and Cultural Change. Spring term. Credit three hours. T Th 10:10–11:25. M. L. Barnett.
Analysis of planned social change programs in predominantly agricultural societies. Focusing on problems of administration, socio-economic development and the introduction of new practices and techniques. Data on resettlement, community development, irrigation and the social problems of new high-yielding grain varieties will be considered. Designed for students concerned with professional or technical work in transitional social systems.

356 (412) Rural Society in America. Fall term. Credit three hours. S-U grades optional. M W F 9:05. E. W. Coward, Jr.
The focus is on the rural sector of American society. Sociological perspectives will be used to examine the nature of present rural society

and its historical development. Attention will be given to past and present policies regarding the use of natural resources, technological improvements, access to economic markets and patterns of political influence.

380 Independent Honors Research in Social Science. Throughout the year. Credit one to six hours. Open only to candidates who have met the requirements for the Honors program. A maximum of six credits may be earned in the Honors Program.

441 (511) Introduction to Urban and Regional Theory. Fall term. Credit three hours. S-U grades optional. Upper class and graduate student status or consent of an instructor. T Th 9:05 plus one discussion hour to be arranged. P. R. Eberts. Students registering for this course must do so under their respective college course number (Also given as PPRA 410–510).
An interdisciplinary course focused upon social, political, and economic aspects of regional America. Viewed from the perspective of demography, ecology, social organization and planning, the emergence of a new society and its implications for contemporary America will be considered.

471–491 (350–352) Informal Study. Throughout the year. Credit one to three hours. S-U grades optional. May be repeated. Undergraduates must attach to their preregistration material written permission from the faculty member who will supervise the work and assign the grade.

471 (350) Readings

481 (351) Research Experience

491 (352) Public Service Experience

492 (353) Undergraduate Teaching Experience. Fall or spring. Credit one to three hours. S-U grades optional. Assistants only. May be repeated. Participation in the ongoing teaching program of the department. Undergraduates must attach to their preregistration material written permission from the faculty member who will supervise the work and assign the grade.

606 (420) Social Change in Community and Regions. Fall term. Credit three hours. S-U grades optional. M W F 11:15. F. W. Young.
A general review of theory, empirical studies and policy prescriptions as applied to communities and regions, especially those in less developed countries. The macrodiffusionist perspective, human ecology, the Weberian tradition, central place theory, Neo-Marxist economic structuralism, and symbolic structuralism are compared. Their capacity to interpret social change in subnational units is assessed with respect to the role of technology, innovation, growth, decline, stagnation, dualism, social movements, and conflict.

618 (514) Research Design I. Fall term. Credit four hours. M W F 10:10. J. D. Francis.
This is the first of a two-semester sequence in graduate-level research methods dealing with data-gathering problems (either course may be taken individually). The first part of this course discusses essentially problems of measurement. Emphasis is upon the design of measuring instruments, problems of reliability and validity. Some common forms of measuring instruments will be discussed: paired comparisons, Likert and Guttman scales and some discussion of multidimensional techniques. Factor analysis will be included. The sequence in graduate methods will deal with sampling frames and some pragmatic techniques as well as some discussion of statistical analysis procedures appropriate under each. A third part of the course will discuss problems of research design and legitimacy of inferences. Throughout the course students are expected to use actual data and thus familiarize themselves with data handling and processing.

619 (515) Research Design II. Spring term. Credit four hours. Prerequisite: an introductory methods course or a statistics course. M W F 10:10. J. D. Francis.
An intermediate level treatment of the following topics: nonexperimental designs, regression analysis, analysis of variance, analysis of covariance, and causal models. A classic piece of sociological research will be one source of illustration and laboratory exercises.

631 (498) Community Structure and Aging. Fall term. Credit three hours. Open to seniors and graduate students. S-U grades optional. T Th 2:30–3:45. P. Taietz.
A model for conceptualizing and measuring the dimensions along which communities vary will be studied. The implications of the model for social planning and public policy will be examined in the context of the community's aging population. Special attention will be given to community programs, facilities, and services for the aging and to the impact of community environment on the behavior and attitudes of the aging.

632 (421) Community Structure and Planned Change I. Fall term. Credit three hours. W F 1:25–2:40. H. R. Capener and E. C. Erickson.
Part I of this two-semester course analyzes the patterns of community structure in terms of strategy implications for change and development. Examined also are the relational forms of horizontal and vertical linkage, the form and function of community power and the inter-

relationships of these and other variables of community dynamics in a system context. Materials are drawn from case studies and interaction with community officials and leaders.

633 (411) Community Structure and Planned Change II. Spring term. Credit three hours. Prerequisite: R.S. 632. T 12:20–4:40. H. R. Capener and E. C. Erickson.
Part II builds on the prerequisite of Part I above and is devoted to a semester of applied field experience involving actual contributed work in an agency, organization or project wherein a program has been worked out and approved by the instructor. A final written project report completes the supervised field experiment.

635 (522) Social Power and Community Change. Spring term. Credit four hours. T Th 10:10–12:05. A. D. Milnor.
A sociopolitical approach to power as an aspect of community life. Methodological and theoretical approaches of recent community power studies are analyzed. Representativeness, responsiveness, and output of decision-making structures and effectiveness of change strategies are considered.

652 (501) Interdisciplinary Perspectives on Development. Fall term. Credit three hours. Graduate students or consent of instructor. T 2:30–5:30. G. J. Cummings.
A comparison of several conceptual frameworks relevant to human development. The central purpose of the seminar is to explore the possibility of designing a more comprehensive theory of development.

661 (437) Differential Life Styles of the Aging. Spring term. Credit three hours. Open to seniors and graduate students. S-U grades optional. T Th 2:30–3:45. P. Taietz.
The life styles of the aging will be analyzed and evaluated from the standpoint of disengagement theory, age segregation versus age integration, and the retirement process. A study of research literature, some interaction with older persons in a variety of living arrangements, and field trips will provide students with a basis for proposing innovative life styles as well as modifications in the present arrangements.

711 The Design of Social Organization Research. Spring term. Credit three hours. Prerequisite: consent of instructor. T 12:20–2:15; Th 12:20–1:05. D. E. Moore and J. D. Francis.
The purpose of this seminar is to provide the student with the opportunity to design a substantial empirical study in social organization. The first part of the semester will be a critical review of exemplary studies in sociology focusing on the theoretical context, the choice of methods, and the implications of each for the findings and conclusions. The second part of the semester will be a discussion of student proposals.

[712 Factor Analysis and Multidimensional Scaling. Fall term. Credit four hours. M W F 10:10. J. D. Francis. Not offered in 1974–75.
Topics which will be discussed during the semester include: philosophy of factor analysis, factor analysis models, the factoring design, factoring techniques, an overview of multidimensional scaling and a comparison with factor analysis models, an in-depth investigation of Smallest Space Analysis, MDSCAL and other multidimensional scaling techniques. The student must have some previous coursework in scaling and statistics. As matrix algebra is an integral part of these procedures some class time plus extra sessions will be devoted to this topic. The student is expected to complete several labor assignments using the techniques.]

[715 Macrosociological Description of a Single Country. Spring term. Credit four hours. T Th 2:30–4:10. F. W. Young. Not offered in 1974–75.
Designed for students who want to learn how to make a sociological description of a whole country. Each student is guided throughout the term in constructing a potentially interdisciplinary analysis of a country he has chosen for study. Topics covered: the country's place in various international hierarchies; the identification of political units, bureaucracies, corporations, and development projects; changes in the status of ethnic groups and political parties; the organization of agriculture; population movements, etc. The course begins with simple descriptive materials from a variety of mostly less developed countries, but including states of the United States. It moves on to standard categories and indices and a recently developed system of macrosocial accounting.]

716 (516) Macrostructural Research Methods. Spring term. Credit four hours. T Th 2:30–4:10. F. W. Young.
The comparative study of large social systems is presented as a new research style that is especially appropriate to research in and on developing countries. The field technique of macrosurveys and the uses of available data such as national social accounting, documents, ethnographic reports, and aerial photographs are emphasized. Special attention is given to trend studies; the assumptions of macrostructural analysis; rapid, low-cost research procedures; and the mechanics of data archives.

[717 Regression and Path Analysis. Spring term. Credit four hours. Prerequisite: Two courses in statistics and one in methods. M W F 10:10. J. D. Francis. Not offered in 1974–75.
The first part of the course will consist of a review of m and nonlinear regression.
Two stage least squares models will be discussed for sociological data. The latter half of

the course will deal with recursive and non-recursive path models.]

721 (510) Seminar on Decision Making and Social Action. Fall term. Credit three hours. M F 10:10 and a weekly two-hour laboratory. Time to be arranged. W. W. Reeder.
An introduction to research and theory on decision making and social action at the graduate level. The lectures for 210 are used to provide a systematic presentation of the subject, and the two-hour weekly laboratory is used to discuss additional research and theory related to the topics presented.

742 (624) Macro Systems Theory. Spring term. Credit three hours. Given in alternate years. S-U grades optional. Th 10:10–12:20. P. R. Eberts.
Analysis of major theoretical and research problems related to conceptualizing stress areas in society's changing organizational processes. Topics will be covered by reports on major classical and contemporary theorists, paying particular attention to their potentiality, using modern analytic techniques on current issues in political economy.

751 (528) Applications of Sociology to Development Programs. Spring term. Credit four hours. Open to graduate students only. T Th 2:30–4:10. J. W. Converse.
Consideration of problems of implementing change strategies at national, regional, and institutional levels, especially as they relate to rural development. Attention will focus on institutional obstacles to increasing the amount of wealth generated and retained within a system as well as existing patterns of wealth distribution and how these can be changed through developmental programs and processes. An examination of the dependency framework and emerging, literature on societal or developmental change as contrasted to social or evolutionary change. Consideration of the different contexts within which developmental change occurs and the power balances between different actors in international and national systems.

754 Peasants, Water, and Development. Spring term. Credit three hours. Time to be arranged. M. L. Barnett and E. W. Coward, Jr.
This seminar will focus on irrigated agriculture and its relation to agricultural development in both domestic and international contexts. The literature dealing with social processes within irrigation systems and between irrigation systems and their social setting will be reviewed. To provide a comparative perspective, both traditional and modern irrigation systems will be examined. The seminar will be an opportunity to examine systematically the institutional and organizational policy issues associated with the design and operation of systems of irrigated agriculture.

791 (552) Teaching Experience. Fall or spring. Credit one to three hours. Prerequisite: graduate standing. Participation in the ongoing teaching program of the department.

792 (553) Public Service Experience. Throughout the year. Credit to be arranged. Prerequisite: graduate standing. Participation in the ongoing public service activities of the department.

871–874 Informal Study. Throughout the year. Credit to be arranged. Prerequisite: Candidate for master's degree and permission of the graduate field member concerned.

871 Rural Sociology

872 Development Sociology

873 Organization Behavior and Social Action

874 Methods of Sociological Research

881–883 Research. Throughout the year. Credit to be arranged. Prerequisite: Candidate for master's degree and permission of the graduate field member concerned.

881 Rural Sociology

882 Development Sociology

883 Organization Behavior and Social Action

971–974 Informal Study. Throughout the year. Credit to be arranged. Prerequisite: Candidate for Ph.D. degree and permission of the graduate field member concerned.

971 Rural Sociology

972 Development Sociology

973 Organization Behavior and Social Action

974 Methods of Sociological Research

981–983 Research. Throughout the year. Credit to be arranged. Prerequisite: Candidate for Ph.D. degree and permission of the graduate field member concerned.

981 Rural Sociology

982 Development Sociology

983 Organization Behavior and Social Action

Statistics and Biometry

200 Statistics and the World We Live In. Fall and spring term. Credit three hours. Lecture, T Th 11:15. And one of the following discussions: Fall term, M 10:10, 1:25, 3:35; T 9:05; Th 1:25, 2:30; F 9:05, 11:15. Spring term: M 10:10, 1:25, 3:35; T 9:05; Th 1:25; F 9:05, 11:15. Th 2:30. Preliminary examinations to be given on Thursday evenings of the 5th and 11th weeks. F. B. Cady.
Emphasis is on the development of a critical attitude for evaluating data and formulating

opinion in the face of uncertainty. Involves numbers and the use of numbers as related to the many aspects of society. Importance will be placed on obtaining meaningful data related to a phenomenon of interest, and upon designing information into data. Elementary concepts of populations, sampling from populations, model building, probability, frequency distributions, sample surveys, and experimental designs will be presented. Principles of statistical inference are covered through point and interval estimation. An introduction is given to the basic concepts and definitions in measurement, the principles of scientific experimentation, and graphical presentations. Emphasis will be on ideas, concepts, and understanding rather than on methods.

408 Probability and Statistics I. Fall term. Credit three hours. Prerequisite: Mathematics 106, 108, or 112 or consent of instructor. M W F 10:10.
An introduction to the theory of probability, random variables, probability models, probability distributions, generating functions, and limit theory; biological and statistical applications serve to motivate the presentation.

409 Probability and Statistics II. Spring term. Credit three hours. Prerequisite: course 408 or equivalent. Lectures, M W F 10:10.
The concepts developed in 408 are applied to provide an introduction to the theory of statistical inference. Topics covered include decision theory, sufficiency, estimation, hypothesis testing and linear regression. Biological applications again serve to motivate the presentation.

[411 Stochastic Models in Biology. Spring term. Credit three hours. Prerequisite: 409. Lectures, M W F 10:10. Discussion period to be arranged. Professor to be appointed. Not offered in 1974–75.
An introduction to stochastic processes in biology. The necessary mathematics and statistics will be introduced as needed. Recurrent events, random walk models, Markovian processes, birth-and-death processes, epidemic processes, competition and predation, diffusion processes, and other models currently used in biological theory will be discussed and applied. Special emphasis will be given the various processes applied to genetics.]

[412 Deterministic Models in Biology. Spring term. Credit three hours. Prerequisite: 409. Lectures, M W F 10:10. Discussion period to be arranged. Instructors to be appointed. Not offered in 1974–75.
An introduction to deterministic mathematical models in biology. The application will be from the biological viewpoint. The necessary mathematics will be introduced as needed. Finite differences, differential equations, logistic, growth and decay, and other deterministic models corresponding to those introduced in 411 will be discussed.]

417 Matrix Algebra. Fall term. Credit three hours. Prerequisite: the equivalent of one year of college algebra. M W F 8. Discussion section to be arranged. S. R. Searle.
Basic matrix algebra with applications in biology, business, economics, and statistics. Arithmetic procedures and other matrix operations; determinants, rank and linear independence, latent roots and vectors, solving linear equations, generalized inverses, direct sums and products. Use of matrices in regression analysis and linear statistical models.

500 Biometry Seminar. Each term. Credit one hour. S-U grades only. Th 4. Biometrics Unit Staff.

510 Statistical Methods I. Fall term. Credit four hours. Prerequisite: graduate status or permission of instructor. M W F 9:05. Laboratory to be arranged. Examinations will be held at 7:30 p.m. on Wednesday evenings. C. L. Wood.
The use of probability models to portray the variations of observations arising through experimentation in biology and other fields is considered. Particular attention is given to the binomial, the Poisson, and the normal probability models. Techniques are developed for utilizing the information contained in observations arising from a specific population to make inferences about characteristics of the population. Topics include point and interval estimation, tests of hypotheses, inference for a single population, comparisons between two populations, regression and correlation analysis, and the one-way analysis of variance. Both parametric and nonparametric procedures are discussed. Emphasis is placed on basic statistical principles, criteria for selection of statistical techniques and the application of these techniques to a wide variety of biological situations.

511 Statistical Methods II. Spring term. Credit four hours. Prerequisite: 510 or the equivalent. M W F 9:05. Laboratory to be arranged. Examinations will be held at 7:30 p.m. on Wednesday evenings. C. L. Wood.
The work of 510 is continued. Topics include multiple and curvilinear regression, complex analysis of variance and covariance. The analysis of variance discussion considers treatment designs, single degree of freedom contrasts, the simpler experimental designs, sampling errors, fixed, mixed and random models, and the effect of disproportionate numbers.

513 Design of Experiments I. Fall term. Credit four hours. Prerequisites: 417 and 511, or the equivalent. M W F 8. Discussion period to be arranged. W. T. Federer.

Principles and techniques of experimentation, theoretical concepts, extensions and variations of the completely randomized, randomized complete block, and latin square designs, the factorial experiment and confounding, fractional replication including response surface designs, lattice designs, crossover designs, augmented and other designs, covariance analyses, error rates, tests and interval estimation for ranked means, sample size, variance component analyses, unequal number analyses, the place of orthogonality in design, and advanced statistical methodology under various fixed, mixed, and random models. Problem formulations and solutions are stressed.

514 Design of Experiments II. Spring term. Credit four hours. Prerequisite: 513. M W F 8. Discussion period to be arranged. W. T. Federer.
A continuation of the work in 513 with emphasis on the role of confounding in experimental and treatment designs. Special attention is paid to split-plot and split block confounding schemes and algorithms for distinguishing between whole plots and split plots. Generalized forms of analyses and construction are presented followed by a discussion from selected topics, on long-term experiments, combination of results from several experiments, sequential experimentation, variance component analyses, estimation procedures, linear hypotheses, heritability studies, multivariate analyses, unequal numbers analyses and their one-to-one correspondence with fractional replication, and related topics.

517 Linear Models. Spring term. Credit three hours. S-U grades only. Prerequisite: 417, 511, and 409 or Mathematics 472. T Th 10:10–11:25. S. R. Searle.
Introduction to multinormal variables and distribution of quadratic forms; linear statistical models, estimable functions, and testable hypotheses; regression models, experimental design models, variance components models, and combinations thereof.

518 Selected Topics in Biometry. Spring term. Credit three hours. Prerequisite: 511 and 409 or the equivalent. Time to be arranged. D. S. Robson.
Topics will be selected from a list including the principles and methodology of bioassay, biosampling, nonparametric methods, mark-recapture methods, and statistical genetics.

519 Multivariate Theory and Application. Fall term. Credit three hours. S-U grades only. Prerequisites: 417, 511 and 409 or Math 472. T Th 10:10–11:25. S. R. Searle.
Most of the topics in the Anderson text *An Introduction to Multivariate Statistical Analysis* will be covered: multinormal variables, estimation, Wishart distribution, generalized T^2 and generalized variance, principal components, canonical correlations, and factor analysis, with emphasis on derivation of principle results.

[520 Design of Experiment III. Fall term. Credit three hours. Prerequisite: 417, 514 and Mathematics 431–432 or the equivalent and consent of instructor. M W F 8. W. T. Federer. Not offered in Fall 1974.
A mathematical development of the properties, construction, and analysis of experiment and treatment designs. Proofs to be given for known results and problems to be formulated in mathematical terms.]

499 Special Problems in Statistics and Biometry. Fall, spring, or summer. Credit one or more hours by arrangement with instructor. Prerequisite: permission to register. Biometrics Unit staff.

Introduction to Computer Uses in Data Analysis (Rural Sociology 314). Fall. Credit three hours. T Th 11:15.
An introductory course in computing open to all students with interests in analyzing data: preparation and description of data; preparing and running computer programs using the FORTRAN language; computer attributes and applications; library programs and associated facilities.

Vegetable Crops

103 General Horticulture. Spring term. Credit four hours. Lectures, M W F 8. Laboratory, M T W or Th 2–4:25. Limited to 25 students per laboratory section. R. Sheldrake.
An introductory course in general horticulture, including flower, fruit, and vegetable growing. Intended primarily for students who want a general knowledge of the subject, and for those who wish to specialize in some field of horticulture but have limited background either in practical experience or in training in botany and agronomy.

123 Organic Gardening. Spring term. Credit two hours. Limited to twenty students per section. By permission only. No preregistration. T W or Th 1:25–4:25. W. C. Kelly.
A combined discussion and laboratory course for students with little or no agricultural background. Some of the concepts of organic gardening are explored through discussion of the scientific literature and by growing plants in the greenhouse. Each student must lead a discussion and write a paper on an appropriate topic.

210 Vegetable Types and Identification. Fall term. Credit two hours. T 2–4:25. L. D. Topoleski.
Designed to acquaint the student with the vegetable species grown in the Northeast and

the pests and disorders encountered in their production. Subjects covered include identification of economically destructive weeds, diseases and insects of vegetables; identification of vegetable and weed seeds, seedlings, nutrient deficiencies and vegetable judging, grading and grade defects.

[211 Commercial Vegetable Crops. Fall term. Credit four hours. Should be preceded by elementary courses in agronomy, botany, and chemistry. Prerequisite: 103 or its equivalent. Lectures, M W F 11:15. Laboratory, W 2–4:25. Instructor to be determined. Not offered in 1974–75.
Intended for those interested in the commercial vegetable industry from the viewpoint of production, processing, marketing, or the related service industries. Topics included are techniques, problems and trends in the culture, harvesting, storage, and marketing of the major vegetable crops including potatoes. Several field trips are taken during the laboratory period and one or two week-end field trips are taken early in the fall.]

312 Post Harvest Handling, and Marketing Vegetables. Fall term. Credit three hours. Lectures, T Th 9:05. Laboratory, Th 2–4:25. F. M. Isenberg.
Practices and procedures used in marketing and shipping vegetables. Topics covered include legal structure of the market system, grade standards and methods of grading, the physical and legal aspects of packages, harvesting methods, hydrocooling, vacuum cooling and refrigeration principals, storage techniques and market preparation, use of sprout inhibitors and other chemicals, and objective methods used in quality control. Several field trips will be taken in early fall.

331 Undergraduate Research. Fall and spring terms. Credit one or more hours a term, by arrangement. Undergraduates must attach to their preregistration material, written permission from the staff member who will supervise the work and assign the grade. Any member of the staff.
Special problems may be elected in any line of vegetable work.

401 Vegetable Crop Physiology. Fall term. Credit five hours. Prerequisite: 211 and Biological Sciences 240 or their equivalent. Lecture, M W F 11:15. Laboratory, M 2–4:25. Discussion period to be arranged. Th or F afternoons. W. C. Kelly.
The physiological bases of cultural practice and the application of these principles to problems in vegetable production. Original literature is used to illustrate the principles involved. Experimental material is studied in the laboratory to amplify lecture topics. Subjects discussed include mineral nutrition as influenced by fertilization programs and crop sequence; nutrient interactions and induced deficiencies; growth and development; flowering; fruit setting; growth correlation; senescence; sex expression; photoperiodism; vernalization; and environmental factors affecting growth.

413 Kinds and Varieties of Vegetables. Fall term. Credit three hours. Offered in alternate years. Prerequisite: 103 and 211 or permission to register. Laboratories, W F 2–4:25. Classes will meet at 1:30 August 28, 29, and 30 with excused time for registering. P. A. Minges and staff.
Designed to help students achieve proficiency in the evaluation of vegetable varieties through study of their origin, characteristics, adaptation, and usage. An important part of the course is the study of crops in the field. The vegetable seed industry is also discussed.

[429 Special Topics in Plant Science Extension. Spring term. Credit one hour. (Additional credit by special arrangement.) Offered in alternate years. Lecture, F 8. Discussion period, F 2–4. P. A. Minges. Not offered in 1974–75.
Designed for graduate students and advanced undergraduates in the several plant science fields who wish to acquire a knowledge of extension activities in preparation for careers in extension and associated work, such as research and technical work in both public and commercial organizations. Topics are related to extension in other countries as well as in the United States. Staff members from other plant science departments collaborate in teaching the course.]

501 Research Methods in Applied Plant Science. Spring term. Credit three hours. Offered in alternate years. Prerequisite: permission of the instructor. Combined lectures and discussions, T Th 9:05. W. C. Kelly.
The planning of research programs as influenced by various economic, administrative, political, and geographic environments. The advantages and limitations of conventional experimental designs as they apply to specific research problems. Discussions include a critical interpretation of experimental results from the literature. Many topics are directly applicable to the student's thesis research program.

520 Teaching Experience. Fall or spring. Credit one or more hours by arrangement with the instructor. Members of the staff.
Participation in the teaching program of the department.

531 Graduate Research. Fall and spring terms. Credit one or more hours a term, by arrangement. Graduate must attach to their preregistration material written permission from the staff member who will supervise the

work and assign the grade. Any member of the staff.
Research may be elected in any line of vegetable work.

601 Seminar. Fall and spring terms. Required of graduate students taking either a major or minor in this department. Undergraduates are welcome. Th 4:30. Members of Department staff.

610 Special Topics in Vegetable Crops. Fall and spring terms. Credit to be arranged. Prerequisite: permission to register. Time to be arranged. J. L. Ozbun.

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